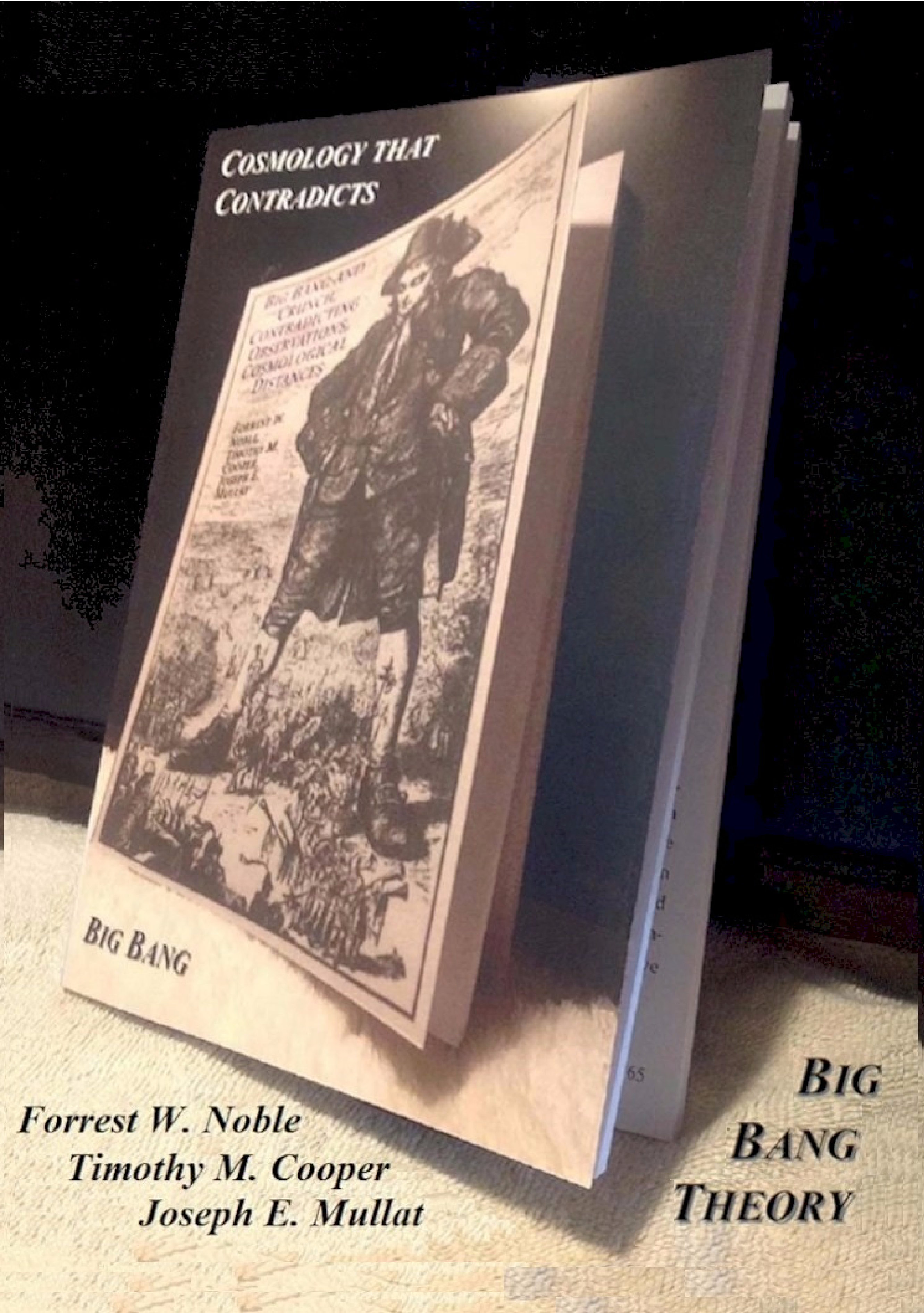

BIG BANG THEORY

Forrest W. Noble
Timothy M. Cooper
Joseph E. Mullat

Cover Illustration by J. E. Mullat

- **The Big Bang and the Big Crunch**

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Luke Mastin

- **A Clear and Certain Path Replacing the Lambda Cold Dark Matter Model**

With a more observationally Variable
And much less-problematic Cosmology

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- **Background Field Flow Dynamics Exact Calculations of Spiral Galaxy Rotations**

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California, USA
Montreal, Quebec, Canada

- **Hubble-Independent Procedure Calculating Distances to Cosmological Objects**

Joseph E. Mullat

- **An Experiment Comparing Angular Diameters Distances Between Pairs of Quasars**

Joseph E. Mullat and Forrest W. Noble

Project and Technical Editor: J. E. Mullat, Copenhagen 2022

ISBN-13 978-9403-67-421-6

Private Publishing Platform
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COSMOLOGY THAT CONTRADICTS THE BIG BANG THEORY

The Standard and The Alternative Cosmological Models,
Newly proposed background field vortex flow forces
Distances Calculation to Galaxies without Hubble Constant,
An Experiment comparing angular Diameter Distances

For the alternative cosmological models discussed in the book, distances to galaxies are calculated without using the Hubble constant. Initially, in the present and in the future, a new space in the form of a quantum vacuum and matter will arise independently in the Universe as a result of parallel and simultaneous gravitational interaction, forming a new quantum vacuum and visible matter. The average energy density in the Universe decreases, new regions appear, previously being hidden under the quantum transition from the hypothetical Background Gravitational Field. When a minimum (average critical energy density) is reached, the gravitational transition to quantum vacuum and visible matter will begin to decrease its acceleration. We recreated the inflationary phase of the Universe based on the postulate of decreasing density. An experiment was also carried out to compare the angular diameters of the distances between pairs of quasars according to data from open access.

Unlike all known geometric models of the Euclidean metric space, the gravitational transition of the Background Gravitation Field into matter, respectively, would presumably occur in the metric space of the stereographic projection into the three-dimensional surface of the four-dimensional manifold. It doesn't matter how we describe energy-field, calling it ether, gravitons, or vice versa, converting it back into the ether or energy-field. It should be clear to everyone that this renaming does not change the essence of the gravitational transition.

About the Authors

Forrest W. Noble

Pantheory Research Organization. Forrest Noble Director: Our published research papers to date relate to theoretical cosmology and related theoretical physics. Most of this work promotes alternative explanations and equations contrary to dark energy, dark matter, Inflation and Big Bang cosmology in general.

One of Tim's interests in the contrarian theory herein is that it contradicts major aspects of most theories in modern physics yet it cannot be disproved by observations to date based upon alternative interpretations of them. Tim is a stress engineer in the aerospace industry and has a Master's degree in Systems Engineering.

Timothy M. Cooper

Joseph E. Mullat

Joseph Emmanuel Mullat currently works as Independent Researcher. Joseph does research in Game Theory, Public Economics, Optimal Taxation, Data Analysis and Cosmology. The most recent publication is 'On the Possibility of Describing Events in Cosmology at the Scale of Average Relativistic Density of Matter'.

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THE DIVINE AND THE NATURE OF EXISTENCE

When God decided to create the Universe, there was nothing at all—no time, no space, no light, no darkness, just nothingness. However, within this emptiness, there was a special entity, a kind of nothingness, but consisting of numerous entities, from very tiny quanta, each with huge energy, transparent in their extension and beautiful in their essence. There was nowhere to place this nothingness—neither here, nor there, neither above, nor below, neither to the left, nor to the right, neither forward, nor backward.

But if God wanted to create something, then this creation had to be placed somewhere. Perhaps God did not have the foresight, and so we humans need to act wisely and think rationally to comprehend the vastness and complexity of the universe. It might be that divine wisdom fell short in this instance. And for us humans to understand how big and complex the Universe is, we need to use our intellect. We may even need to create a special place for everything that will fit, such as a large empty space like a vacuum or something specific like the Aether that we don't even know about yet. Here is a book about how empty space unfolds from nothingness.

Critical Views, credits from Public Domain

It seems to me (ie., for the writer of this critical lines, which follows; the source will not be disclosed, ed.) that Scientists "invent" some concepts in order to prevent their old ideas becoming untenable. Dark Matter and Dark Energy are "inventions" that highlight the errors in current theory, they just do not really exist, and a modification to current theory is required to "fix this up". For instance "dark matter" is supposed to be 80% of all the matter in the Universe. What it is telling me (author of these current lines, ed.) is current theories of Gravitation and the Big Bang are out by nearly an order of magnitude. You can "keep" the current theory only if you "balance the books" using a "huge fudge factor". The real problem is quantum entanglement has not been introduced into theories of cosmology yet and that is where the problem is. Space-time is not primary to the Universe and it is the pre-existing geometry that is "real". It illustrates just how little science knows and how reactionary it is to any change. There are plenty of theoretical solutions to this problem but the "elephant in the room" is there is a reluctance to commit to primary research in the areas that will cause real change because change is going to hurt a large number of established reputations. Therefore the question "What was first: The Dark or the Visible matter", the answer is there can only be one form of matter. Too many people are watching Star Wars and have turned to the "Dark Side" for answers and are not keeping a weather eye on their instruments. If they finally find "the elephant", they will be attacked and savaged by those who have their pensions to protect.

"In the beginning, there was nothing. Well, not quite nothing – more of a Nothing with Potential. A nothingness, in which packets of energy fleeted in and out of existence popping into oblivion as quickly as they appeared. One of these fluctuations had just enough energy to take off. It inflated wildly out of control – one moment infinitesimally small, moments later light-years across. All of space and time was created in that instant, and as that energy slowed, it cooled and froze into matter – protons and neutrons and photons. This baby Universe kept expanding, over billions of years, and those particles coalesced into stars and planets and eventually humans." Source unknown

Preface

Cosmological phenomena are not exactly a subject of physical science as many might think. We cannot perform experiments on the Universe. In contrast, physics is a science, where researchers can conduct experiments on various natural phenomena that can be reproduced by others in a laboratory. In cosmology, we can only look at the skies and speculate what stands behind the light reaching our telescopes. [1]

We can predict the location of planets and stars at closer distances by applying classical Newtonian mechanics, when we use the ordering of the events on the time scale. Still, cosmology relies on numerous pictures of the Universe, aiming to shed some light on phenomena at far away distances. Of course, researchers can verify the correctness of the mathematical reasoning performed by their colleagues, but this does not bring them closer to the truth hidden in the vast expanses of the Universe.

The dark matter is an example of such speculation that is inherent in the study of the Universe. Cosmologists call something that cannot be explained as dark matter, and have even introduced the concept of dark energy. Yet, despite these many assumptions and speculations, cosmology is very interesting and useful, even if it is not an experimental science. Remember Aristarchus, who with his primitive tools needed only

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[1] Disney, M. J., "The Case Against Cosmology," Physics and Astronomy, Cardiff University, Cardiff CF24 3YB, Wales, UK.

common sense and the knowledge of trigonometry to calculate the distance from the Earth to the Sun with great accuracy, using only the dimensions of the Earth's shadow projected onto the Moon's surface. Aristarchus from Samos, fl. c.310 BC — c.230 BC, was a Greek astronomer and mathematician of the Alexandrian school. It is said that he was the first to propose the heliocentric theory of the Universe.

As cosmologists also speculate about the origins of the Universe, they posit neither existence of some point prior to which neither time dynamics nor space existed, and refer to it as singularity problem of time. Some kind of energy field seems largely to determine such origin and dynamics of cosmic objects and the Universe as a whole. Given this assumption it is reasonable to speculate about the Universe dynamics. One of the common mathematical tool suitable for this purpose might be a energy vector or background field — the oblivion where the events of matter creation may happen.

Space and time despite the speculations still are subjects of physical science and are defined in general terms, by presently accepted theory, as fundamental structures for coordinating objects and their states: a relationship system that reflects the coordination of coexisting objects (distance, orientation etc.), together form space, and a relationship system that determines the consistency of successive states or phenomena of flow-series events, ordering, preferences, etc., together accordingly form time. The space in which we live – the usual three-dimensional space – is a physical object bounded by a certain set of parameters, the change of which over time is described by dynamic systems.

It seems, however, that the mathematical apparatus of dynamic systems is quite sufficient for solving problems associated with the motion of matter in the Universe. Indeed, *"Theories in physics are not at all hypotheses, they are not just supported by more or less numerous facts. Theories should have consistent math, such as topology. If the physical theory does not obey the topology, it is incorrect. Topology lays the foundation for physics, not vice versa,"* (Public Domain, Researchgate 2019). However, the theory of space, based on the topological principles of General Relativity (GR), brought problems related to space and time, perhaps, to a dead end, both in cosmic dynamics systems and in the attempts to form a quantum theory of gravity. In such a situation, there naturally arises the need for alternative approaches to the description of reality. Unfortunately, the choice of alternative paths is somewhat limited, and if such a path is indicated, one must first understand the situation, what it looks like at present, and then try to determine any contradictions between the observations and theory. Finally, try to offer something new, even if it is not as perfect as hoped, for example to deviate from the quest to explain all the reality and settle for an insight of a lesser magnitude. This is our motive for narratives offered to a thoughtful reader.

In the first narrative, a modern view of cosmological reality is given, as it is taken from a standard perspective. The obvious sign of the standard view is the concentration of activity, not in solving some physical problem or better explaining observed reality, but in discussing the options of "falling into black holes", "parallel worlds", discussing the possibility of getting into the past, and the like. All of these ideas lead to great science fiction but highly questionable science.

There are also many alternative cosmologies to the Big Bang model. Most of these are unknown to mainstream theorists since professional theorists proposed few of them. Indeed, most of them can be considered steady-state theories, meaning that the observable universe would look generally the same everywhere in time and therefore would be much older, or could even be infinite in age and size. Most of such models have a different explanation for galactic redshifts. One of these theories is discussed in some detail in the second narrative, as well as an extensive redshift comparison of calculated distances in the latter part of the book in both the third and fourth narratives.

In the second narrative, based on factual material, a thoughtful reader will become familiar with a number of contradictions and paradoxes of the standard model of the Universe. Many researchers and theorists, in order to explain the paradoxes, try to expand the mathematical apparatus to the point of absurdity using various paradoxical mathematical constructions. Indeed, in many cases it is possible. However, it is far from common sense, which people have long used to form a theory, contemplate and explain reality.

As stated above, there have been many other similar hypotheses (e.g., tired light) like this since Fritz Zwicky first proposed most famous one in 1929. Zwicky suggested that if photons lose energy over great distances through collisions with other particles in a regular way, the more distant objects would appear redder closer ones. The spectral lines of the elements that produced the initial light would become longer because of these collisions and therefore shifted toward the red spectrum, redshifted from where they started. Aside from the tired light proposal, the regional differences in redshift remain unexplained and of the few who know of it, many of those believe the effect is too prevalent to be a coincidence. Indeed, too much of the aging idea is no longer endorsed by any theorists and nearly all astronomers would scoff at the conclusions drawn in the above view of present theory, and because the logic solely fails in light of present day observations.

Today nearly all astronomers would say that this hypothesis of tired light was worse than just unsatisfactory; they would say that it has been disproved because of the observed time dilation, the slowing of time causing an event to last longer. This is most noticeable concerning dying stars called type 1a supernova. All this type of supernova have a similar light and time profile whereby the duration of their great brightness only lasts a few days, very close to the same amount of time for relatively close events. Then after peaking, this great brightness steadily dies off in just a few days. It has been shown by a great number of these observations that the farther away these supernovae explode based upon their redshift, the longer the event lasts from our perspective. All observations occur in other galaxies since only a few per millennium are thought to occur in our galaxy. These observations are consistent with the expansion of space whereby wavelengths twice as long would last twice as long since there is nearly the same number of wavelengths per event.

Too much of the above paragraph is no longer endorsed by any theorists and nearly all astronomers would scoff at the conclusions drawn in the above paragraph in light of present theory, and because the logic solely in this paragraph fails in light of present day observations. The proposed abbreviated paragraph is shown below. This is the reason why most astronomers believe that tired light has been disproved. But this is not the end of the tired light story concerning logic.

There are other versions of tired light theory, however, that can accommodate time dilation. One such hypothesis involves the interaction of light with the ether as it travels. The surrounding ether would accordingly absorb some of the EM radiation's energy while stretching it out because of some resistance to the flow of EM radiation. This would explain what is being observed concerning both redshifts and time dilation but would get little consideration from astronomers if the word ether were used. Instead one might use the words background-field, which could mean either a physical or energy omni-present background field in all of space, which could carry and dilate EM radiation.

Upon research one might see still other tired light versions, which also can explain time dilation. For aged-light theory time dilation must be logically explained for any astronomer or student to read further since all have been familiarized with it via related education.

But the theory of the aging of light, presented by the bulk of astronomers, does not require radical additions to the existing physical laws. It was assumed that in intergalactic space there are some particles that, interacting with light, take some of the light energy. In the vast majority of massive objects, these particles are larger than others.

Using this idea, astronomers, as mentioned above, explain the differences in redshift values as follows: light passing through galaxies with a denser cluster of particles encounters more of these particles, and therefore, light loses more energy than light that does not passes through regions of galaxies with lower density. Thus, a larger redshift will be observed in the spectrum of light crossing obstacles (areas with denser clusters of the galactic background), and this will lead to different values of the Hubble constant. In making such arguments, astronomers are thus referring to additional evidence for their theories, which has been obtained from experiments with objects with low redshift.

We will outline a few hypotheses that are not contradicted by time dilation. The first suggests that light interacts with a space medium, reminiscent of the old concept of the luminiferous ether. As light travels over great distances, it might age and lose energy, a concept known as the 'tired light' hypothesis. According to this idea, the farther light travels through this medium, the more its wavelengths stretch, resulting in redshift. Although the term 'ether' is no longer widely used, modern equivalents include concepts such as the zero-point field, quantum foam, gravitons, the Higgs particle and field, and other theorized entities like the background energy field.

Visible matter is tangible and real, but the so-called 'dark matter,' which we will refer to as 'hidden vacuum,' is not. Hidden vacuum cannot interact with light. Among some astronomers, particularly amateurs, redshifts are explained within the framework of a non-expanding universe, where the behavior of light differs from the widely accepted scientific view. This small community of astronomers believes that the non-expanding universe model offers more accurate and realistic astronomical data than the standard model of an expanding universe. They argue that this older model better addresses the discrepancies in the calculated values of the Hubble constant. According to these astronomers, high redshifts could be a global feature of the universe, implying that the universe may actually be static, thereby eliminating the need for a Big Bang theory.

The next hypothesis, while valid, is not generally considered the primary cause of the redshifting of galactic light. This phenomenon is known as gravitational redshifting. Gravity is known to bend the path of light, a process called gravitational lensing. For example, if we measure the spectrum of light from a star located near the disk of our Sun, the redshift will be greater than that of a star located in a distant region of the sky. Such measurements can only be made during a total solar eclipse when stars close to the solar disk become visible against the darkened sky. In this context, we are observing gravitational redshift, which occurs when light passes near the Sun. Gravitational redshifts also occur in a direct line, such as from Earth to the Sun's center, where the central solar light is slightly more redshifted than the light from the Sun's edges, proportional to its distance from the center.

However, the gravitational redshift considered here cannot account for the significant redshifting of light from deep space, as the gravitational effect from such distances is negligible. The resistance of light to gravitational influence alone cannot explain galactic redshifting, even though light traveling farther through the universe would encounter more gravitational resistance. Nonetheless, the bending of light during its journey might also contribute to redshifting by stretching the light waves. While these possibilities are not typically classified as tired light hypotheses, they share a similarity: older, longer-traveling light could potentially be gravitationally redshifted. Additionally, there are other lesser-known hypotheses regarding the redshifting of old light that are not discussed here.

The point of this old-light hypothesis is that there could be other logical explanations for galactic redshifts beyond the concept of expanding space. This raises the question: is the principle of expanding space truly the most logical explanation? Readers should be aware that the entire Big Bang (BB) model relies heavily on the premise of expanding space. If alternative explanations for galactic redshifts are valid, then the foundations of the BB theory, including its distance calculation formulas, could be called into question, as these were developed based on the assumption of expanding space.

But what drives this expansion of space? When you research this question online, you may find that the most common answer involves 'dark energy'—a concept suggesting that space expands due to this mysterious force, while 'dark matter' is often said to cause space to contract. However, what does it really mean for space to expand, and what are dark matter and dark energy?

Despite decades of research, these questions still lack satisfying answers. The nature of dark energy and dark matter remains largely unknown, and there is ongoing debate about whether they even exist at all. These elements are fundamental pillars of the Big Bang model, now referred to as the Lambda Cold Dark Matter (ΛCDM) model. However, resent discoveries made by the James Webb Space Telescope have further complicated our understanding. Observations suggest that some galaxies formed much earlier and are larger than previously expected, challenging the current view of the universe's size and age. These findings have led to new discussions and disagreements within the scientific community, calling into question the completeness of the ΛCDM model and whether it fully accounts for the complexities of the universe.

The fourth foundation pillar of the model is called Inflation, which seemingly is an untestable hypothesis. With all four of the foundation pillars of the theory still unknown hypotheses, what is the likelihood the theory is correct and will remain standing after the James Webb goes up and tests some of its major propositions? One proposition that can be tested then is that galaxy groups and clusters at the farthest distances will contain only young galaxies. If instead galaxy groups or clusters look the same as local groups and clusters, the same as the Hubble Deep Field photograph, the Big Bang model will likely begin to fall because of its present age limitation, 13.8 billion years. There are a number of other serious problems with the Big Bang model; the more well-known of these are discussed in the second narrative in the middle of the book.

One of the problems in cosmology to be discussed in the narrative four is the problem of quasars. Quasars are defined as very massive extremely remote celestial objects presently thought to be at the centers of Active Galactic Nuclei. They emit exceptionally large amounts of EM radiation and typically have a star-like appearance in a telescope. Their brightness overpowers the other parts of the galaxy so no separate redshift for the galaxy can be observed, if it were different from the quasar. Present theory holds that quasars contain massive black holes and may represent a stage in the evolution of some galaxies.

Quasars would seem to be an even greater problem for steady-state cosmologies, which will be later discussed. The Big Bang model asserts that the universe has evolved and that quasars and large radio galaxies are a good example of this. Both appear to preferentially exist at distances in common. But for now we will continue to discuss the characteristics of quasars. So their existence and distribution is believed to fit the evolution of the universe according to the Big Bang model.

One of the most striking features of quasars is that their redshifts are very high compared to those galaxies in our vicinity. This is because quasars have an average distance and centrally cluster at redshifts around $z = 1.7$, with a somewhat normal average range between about $z = 0.1$ to redshifts around $z = 2.5$, with a seemingly normal fall-off thereafter to a present maximum redshift of about $z = 5$, after which little or none can be found. This limit could be because of their relative focus problem to be explained. Quasars are thought to originate from the centers of galactic black holes in some of the largest elliptical galaxies, usually in clusters from which a pair of oppositely emitting polar jets emanate. These jets are almost laser-like in that their directional focuses which are very narrow. The very few of these galactic jets that are closely focused in our direct we observe as quasars, by definition, because of their tremendous relative brightness to other galaxies at the same calculated distances. According to most theorists, mainstream or otherwise, all quasars are believed to come from the centers of what are now commonly called active-galactic-nuclei (AGN's).

While quasar redshifts in our vicinity have an average redshift of about 0.067, some of the redshifts of the most distant quasars are close to a redshift of 5.00. If we accept, like most astronomers, that redshifts are the indicators of quasar distances then quasars would be some of the most distant objects in the observable Universe. And if these redshift calculated distances are correct then these quasars are emitting millions of times more energy than galaxies of their similar type, size, and distances. Taking into account the mainstream distance formula called the Hubble formula, galaxies with a redshift of more than 1.00

accordingly should allegedly be moving away from us at the speed of light, and quasars with a redshift of 4.00 should be moving away from us at 4 times the speed of light. This is explained by the BB model that when the quasar's light that we are now observing was close enough to us that the light could now reach us, but now new light from an equally distant quasar would be beyond the possibility of its light ever getting to us because accordingly the expansion of space, the mainstream model, expands away from us at four times the speed of light for such quasars at these distances and therefore could never reach us again.

It turns out that now we have to scold Albert Einstein? Or are the initial conditions of the problem wrong and the redshift is the mathematical equivalent of processes, of which we have little idea? Mathematics is not mistaken, but it does not give an actual understanding of the processes that are taking place. For example, mathematicians have long proven the existence of additional dimensions of space, while modern science cannot find them.

If quasar-calculated redshifts are accepted as caused by the ordinary expansion of space, the distances indicated are very great, but additional analysis has shown that their surrounding energy emission and energy densities are inexplicable for such distances. On the other hand, if their distances calculated by their redshifts are wrong, there are no mainstream accepted hypotheses about the mechanism which quasar might produce redshifts. But there are other relatively simple non-mainstream hypotheses to explain them. The famous astronomer Halton Arp was most famous for such a proposal, which was a major aspect and promotion of his fruitful, distinguished, but controversial career. Several other prominent astronomers and theorists concurred with his findings based upon the observations and reasoning he presented. By his telescopic observations, and of others, he proposed that most, or nearly all quasars are much closer than their redshifts might indicate. But he and his few followers, some well known, together, were generally dismissed by the mainstream. This is because one of the foundation pillars of modern astronomy and cosmology is the Hubble formula, and the belief that it correctly calculates galactic distances based upon there observed redshifts. Harp's observations, and similar observations by other astronomer, were asserted to be only optical illusions, coincidental, or other seemingly possible explanations. Still his few remaining proponents still make the same assertions concerning the anomalous distances of quasars.

Halton Arp suggested that most or all quasars have an intrinsic redshift to them. This would mean that something is happening inside or immediately surrounding the galaxy, which would create the extent of the observed redshift from our perspective. But what mechanism might that be? There have been several proposals but maybe the simplest logical mechanism would be gravitational redshifting discussed in the paragraphs above. The theory in the second narrative made such a proposal not discussed in this book. It asserts that because the elliptical galaxies producing the quasar, usually in the center of a cluster, are often the largest galaxies of the cluster, therefore their gravity would be very strong. Their galactic core and central galactic black hole would likely have a very strong gravitational influence on light being produced by them. A black hole will prevent any light from escaping it inside its event horizon, but if the galactic black hole is strong enough to redshift its surroundings outside its event horizon, as explained above, this redshifting effect is readily observed as we observed from our sun's light described above. But how much would these quasar-producing Active Galactic Nuclei (AGN) redshift the EM radiation they produce? In the theory of the second narrative this quantity is easily calculated. Looking at a distribution chart of these quasars concerning their redshifts, called a histogram, it can be readily seen that it is very similar to a natural curve, a distribution formula in statistics.

Although all of these AGN galaxies are many times greater in size than the Milky Way, some are still much larger and more condensed than others. In the same way some of them could be only slightly gravitationally redshifted while others gravitationally redshifted to the maximum. If the assumption is made that quasars are instead distributed evenly like other galaxies, then one can calculate the maximum proposed gravitational redshift that the AGN's are producing. This maximum redshift is calculated to be about $z = 1.3$, and progressively decreases thereafter down to only a slight gravitational redshift close to zero. The range of this redshifting calculates to about z (the redshift) $= 2.6$. Add on top of this a normal distribution of these quasar galaxies based upon regularly distributed distances of the volumes they occupy, we come very close to the observed distribution of quasars, of course their distances would then become normally distributed as all other galaxies. For the furthest outliers beyond a redshift of 3, there are additional reasons why this most distant small group of outlying quasar distances could be under-calculated as explained in both the second and third narrative. Also many now believe that the same active galactic nuclei the produce quasars and the same ones that produce high-energy radio galaxies, but we can't see the quasars inside most of them if they are not facing us directly.

There are primarily two major reasons why mainstream astronomers do not want to consider the possibility that quasars are intrinsically redshifted. The first is because it would complicate the picture of the universe in that galactic redshifts would not necessarily be the sole indicator of distances in some cases. If not they would have little else to go by concerning these object's distances. However, in the third narrative of this book in case the energy density surrounding quasars might be determined, if at all possible in at least one or more cases, then, their distances can still be calculated using unique proposal as explained in the third narrative. But secondly, such a contrary determined alternative proposals would be an indicator that the Big Bang model is wrong, since on the bases of the discovery of quasars and radio-galaxies and according to similar but novel Big Bang expansion phenomenon, the universe would have been different in the past as the Big Bang model proposes. Taking these alternative proposals under consideration there would be less supporting evidence for the Big Bang model in general.

Thus, both of the alternatives available within the conventional astronomical theory face serious difficulties. If the redshift is assumed to be the usual Doppler effect due to spatial absorption, as well as spatial expansion, then the indicated distances are so huge that other properties of quasars, especially energy radiation, are inexplicable. If the redshift is not connected, or is not completely related to the speed of movement, we do have, perhaps, in the third narrative a reliable gravitational transition hypothesis about the mechanism, which produces it.

Indeed, in the third narrative, we proceed with the application of our scheme to the matter creation phenomenon. We discuss the possibility of expanding the space given a gravitational transition sequence of high energy cells $A, B, C, \ldots$. Any effect of this transition upon the cells in the surrounding area is then measured a posteriori. Thus, we can arrange conceivable experiments with a tiny piece of matter using Push or Shadow Gravity, i.e., PG vector-field energy potential function responsible for the effect of high-energy cells on a piece of surrounding space. Push Gravity also known as Le Sage's theory of gravitation, is an alternative gravitational theory proposed in 18th century by Georges-Luis Le Sage. [2] In this context, the high energy cells would refer to the likelihood of gravitational transition emerging from the oblivion as a phenomenon of matter. In the same manner it will be possible to determine whether the transition would have positive or negative effects on sequence in progress. However, this would necessitate changing somehow the gravitational transition (inclusion/exclusion) procedure and establishing how the change incurred would be evaluated.

Here it should be emphasized that this is precisely our proposal on the possibility of using the apparatus of combinatorial mathematics anywhere not yet used in topology. In fact, as our analysis of the distance to galaxies shows, we use in the third narrative the so-called apparatus of Monotone Systems borrowed from game theory and data analysis. Although the idea of Monotonic Systems implementation in

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[2] Matthew R. Edwards (Editor). *Pushing Gravity: New Perspectives on Le Sage's Theory of Gravitation*. iv + 316 pp., figs. Montreal: Apeiron Publishers, 2002.

highly diverse research fields of cosmology may seem unexpected, the use of stable/steady lists or topologies of Monotone System *credentials* — the case the PG vector-field potential functions, which provide a unifying perspective for conceivable experiments in calculating distances to galaxies. This is particularly beneficial when employing monotonic mappings producing so called fixed points, (Γ-equation) which preserve stability or equilibrium of lists/topologies of credentials despite the credentials' dynamic nature.

Push Gravity energy potential function is just an example that represents high-energy cells with the inverse monotone property. When a hole/bubble under the action of the "stream" of a new matter expands/inflates, the gravitation potential outside the bubble increases because the total bubble's mass increases at a higher rate, even though *"the energy density"* of matter at each point inside the bubble decreases. We can thus construct once again our fixed-point Γ-equation, finding the roots of the equation as stable points. This is particularly relevant for the so-called inflation stage of the Big Bang. The resulting equation might be parameterized by what is known in astrophysics as a relativistic energy density of energy. The density of energy, rather than time, might thus be the appropriate candidate for the scale like time-line events. Such a scale could be employed to perform our fixed point "experiments" on the Universe via geometrical modeling. Its solution exists even when the radius of topology equals zero – the point on our high energy cells scale at which density of energy is infinite. This parameter provides the opportunity to investigate the topology of the monotone systems apparatus of the Universe while the density decreases on its energy density scale from very high/extreme values to lower ones.

In conclusion, while making the connection between our Cosmological Speculation and the implementation of the monotone apparatus in the third narrative, it is important to note that the architecture of the apparatus is always nested. Really, while the high energy cells grow or decrease, the fixed points shrink in a way akin to a nested structure of subsets in the set theory sense. The solutions of our mathematical Γ-equation lead exactly to similar nested phenomena of topology when applying the General Relativity theory given by a metrical quadratic form as a rod upon the 3-dimensional Euclidian space lying on the 4-dimensional hyper globe surface.

Paying attention to the front cover of our book, it is quite possible that our thoughtful reader will understand what we mean when we talk about the nested structure of the monotonous system. Indeed, on the front cover one book is embedded in the other, and the other in turn is embedded in the third, and so on.

We must emphasize here that our nested structure established from the third narrative monotone apparatus, as roots of our fixed point equation, coincide with Planck Mission measurements of the composition of the Universe with incredible precision. They predict almost $\approx 0.005\%$ to $\approx 0.01\%$ precision the composition of *dark*, *visible matter* and *energy-field* in the Universe. Thus, given that the equation must be calibrated a priori using some parameters, the question is what kind of phenomenon has been created first on the energy density scale – the dark or the visible matter? Our mathematical speculation suggests that the "dark matter" – "hidden vacuum" or whatever is hiding behind this mathematical phenomenon – was allegedly created first. Contrary to presently assumed, almost infinite density, it had a density of a soup in the so-called initial inflation phase of the Big Bang.

It is also thought that the Universe, according to the inflation pillar, was born in the first 10^{-36} s of this process, based on Standard Model. Still, whether the Big Bang ever took place, or whether the density decreased to some level is irrelevant to our discussion, as our results indicate that the "visible matter" emerged "later" on the density scale, accompanying the "dark-matter." This was the best interpretation we can make from the nested structure of Monotonic System with the high-energy cells in the form of PG vector-field energy potential functions. Although it is pure speculation, the calculations that lead to such a conclusion might be interesting to follow. That was the reason for introducing the Monotone Phenomena of the Universe.

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THE BIG BANG AND THE BIG CRUNCH

Designed by Luke Mastin, credits *

Introduction

Most scientists now believe that we live in a finite expanding universe which has not existed forever, and that all the matter, energy and space in the universe was once squeezed into an infinitesimally small volume, which erupted in a cataclysmic "explosion" which has become known as the Big Bang.

Thus, space, time, energy and matter all came into being at an infinitely dense, infinitely hot gravitational singularity, and began expanding everywhere at once. Current best estimates are that this occurred some 13.7 billion years ago, although you may sometimes see estimates of anywhere between 11 and 18 billion years.

The Big Bang is usually considered to be a theory of the birth of the universe, although technically it does not exactly describe the origin of the universe, but rather attempts to explain how the universe developed from a very tiny, dense state into what it is today. It is just a model to convey what happened and not a description of an actual explosion, and the Big Bang was neither Big (in the beginning the universe was incomparably smaller than the size of a single proton), nor a Bang (it was more of a snap or a sudden inflation).

In fact, “explosion” is really just an often-used analogy and is slightly misleading in that it conveys the image that the Big Bang was triggered in some way at some particular centre. In reality, however, the same pattern of expansion would be observed from anywhere in the uni-

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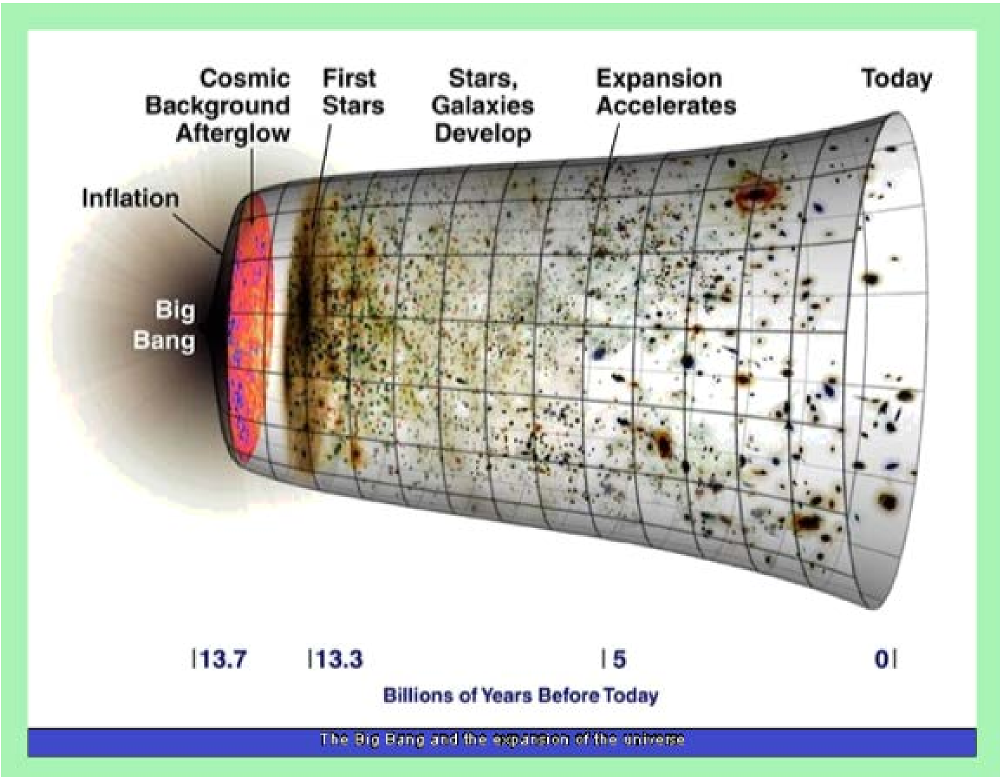
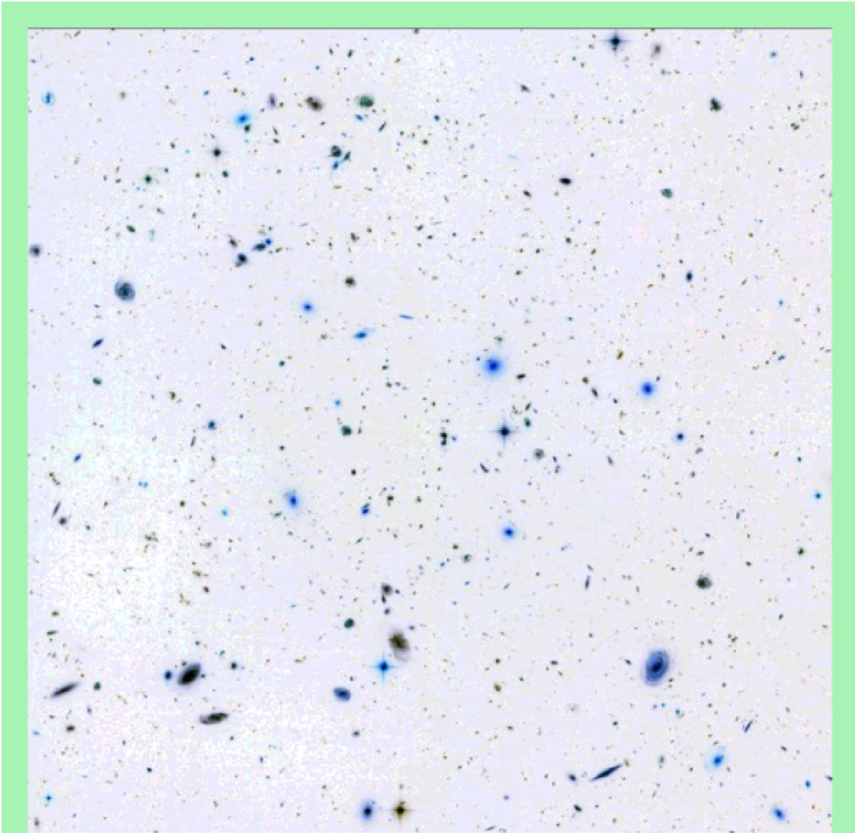
verse, so there is no particular location in our present universe which could claim to be the origin. It really describes a very rapid expansion or stretching of space itself rather than an explosion in pre-existing space. Perhaps a better analogy sometimes used to describe the even expansion of galaxies throughout the universe is that of raisins baked in a cake becoming more distant from each other as the cake rises and expands, or alternatively of a balloon inflating.



Neither does it attempt to explain what initiated the creation of the universe, or what came before the Big Bang, or even what lies outside the universe. All of this is generally considered to be outside the remit of physics, and more the concern of philosophy. Given that time and space as we understand it began with the Big Bang, the phase "before the Big Bang" is as meaningless as "north of the North Pole".



The cosmological principle is supported by pictures of different parts of the universe by the Hubble Space Telescope

Therefore, to those who claim that the very idea of a Big Bang violates the First Law of Thermodynamics (also known as the Law of Conservation of Energy) that matter and energy cannot be created or destroyed, proponents respond that the Big Bang does not address the creation of the universe, only its evolution, and that, as the laws of science break down anyway as we approach the creation of the universe, there is no reason to believe that the First Law of Thermodynamics would apply.

The Second Law of Thermodynamics, on the other hand, lends theoretical (albeit inconclusive) support to the idea of a finite universe originating in a Big Bang type event. If disorder and entropy in the universe as a whole is constantly increasing until it reaches thermodynamic equilibrium, as the Law suggests, then it follows that the universe cannot have existed forever, otherwise it would have reached its equilibrium end state an infinite time ago, our Sun would have exhausted its fuel reserves and died long ago, and the constant cycle of death and rebirth of stars would have ground to a halt after an eternity of dissipation of energy, losses of material to black holes, etc.

The Big Bang model rests on two main theoretical pillars: the General Theory of Relativity (Albert Einstein's generalization of Sir Isaac Newton's original theory of gravity) and the Cosmological Principle (the assumption that the matter in the universe is uniformly distributed on the large scales, that the universe is homogeneous and isotropic).

By the English astronomer Fred Hoyle incidentally coined the phrase The Big Bang (during a radio broadcast in 1949 as a derisive description of a theory with which he disagrees) is now considered by most scientists as the most likely scenario of the birth of the universe. However, this has not always been the case, as the following discussion illustrates.

The Expanding Universe and the Hubble's Law

When Albert Einstein was formulating his ground-breaking theory of gravity in the early 20th Century, at a time when astronomers only really knew of the existence of our own galaxy, he necessarily used the simplifying assumption that the universe has the same gross properties in all parts, and that it looks roughly the same in every direction wherever in the universe an observer happens to be located. Like Sir Isaac Newton two hundred years before him, he assumed an infinite, static or "steady state" universe, with its stars suspended essentially motionless in a vast void.

However, when Einstein tried to apply his General Theory of Relativity to the universe as a whole, he realized that space-time as whole must be warped and curved back on itself, which in itself would cause matter to move, shrinking uncontrollably under its own gravity. Thus, as early as 1917, Einstein and others realized that the equations of general relativity did not describe a static universe. However, he never quite came to terms with the idea of a dynamic, finite universe, and so he posited a mysterious counteracting force of cosmic repulsion (which he called the "cosmological constant") in order to maintain a stable, static universe. Adding additional and arbitrary terms to a theory is not something that scientists do lightly, and many people argued that it was an artificial and arbitrary construct and at best a stop-gap solution.

As we have noted, up until that time, the assumption of a static universe had always been taken for granted. To put things into perspective, for most of history (see the section on Cosmological Theories Through History), it had been taken for granted that the static earth was the centre of the entire universe, as Aristotle and Ptolemy had described. It was only in the mid-16th Century that Nicolaus Copernicus showed that we were not the centre of the universe at all (or even of the Solar System for that matter!). It was as late as the beginning of the 20th Century that Jacobus Kapteyn's observations first suggested that the Sun was at the centre of a spinning galaxy of stars making up the Milky Way. Then, in 1917, humanity suffered a further blow to its pride when Curtis Shapely revealed that we were not even the centre of the galaxy, merely part of some unremarkable suburb of the Milky Way (although it was still assumed that the Milky Way was all there was).

Some years later, in 1925, the American astronomer Edwin Hubble stunned the scientific community by demonstrating that there was more to the universe than just our Milky Way galaxy and that there were in fact many separate islands of stars - thousands, perhaps millions of them, and many of them huge distances away from our own.

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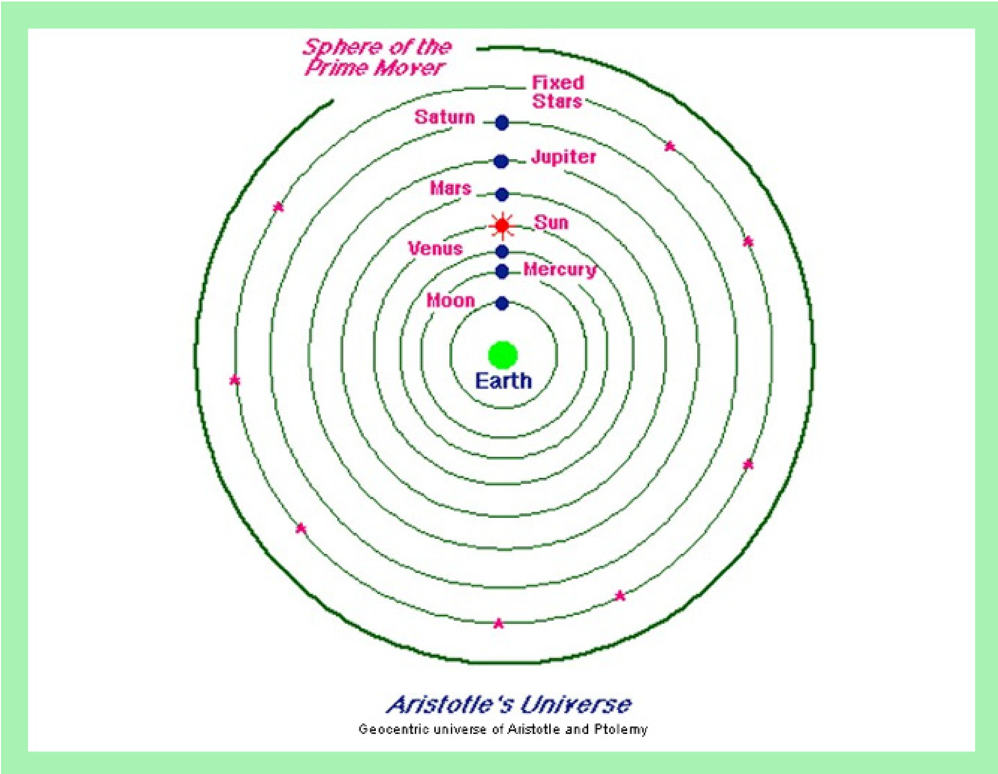
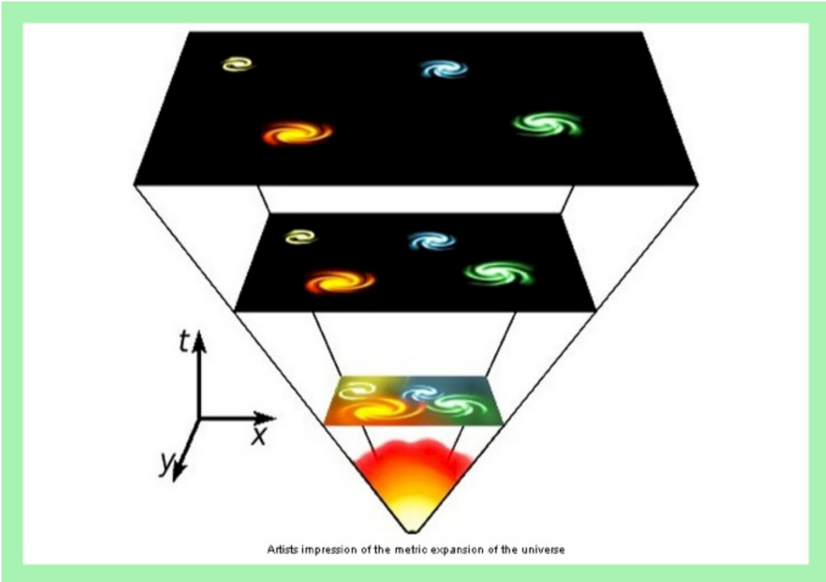


Then, in 1929, Hubble announced a further dramatic discovery, which completely turned astronomy on its ear. With the benefit of improved telescopes, Hubble started to notice that the light coming from these galaxies was shifted a little towards the red end of the spectrum due to the Doppler effect (known as "redshift"), which indicated that the galaxies were moving away from us. After a detailed analysis of the redshifts of a special class of stars called Cepheids (which have specific properties making them useful as "standard candles" or distance markers), Hubble concluded that the galaxies and clusters of galaxies were in fact flying apart from each other at great speed, and that the universe was therefore definitively growing in size. In effect, all the galaxies we see are slightly red in colour due to redshift.

Hubble showed that, in our expanding universe, every galaxy is rushing away from us with a speed which is in direct proportion to its distance, known as Hubble's Law, so that a galaxy that is twice as far away as another is receding twice as fast, one ten times as far away if receding ten times as fast, etc. The law is usually stated as $v = H_0 D$, where v is the velocity of recession, D is the distance of the galaxy from the observer and H_0 is the Hubble constant which links them. The exact value of the Hubble constant itself has long been the subject of much controversy: Hubble's initial estimates were of the order of approximately 500 kilometres per second per megaparsec (equivalent to about 160 km/sec/million light years); the most recent best estimates, with the benefit of the Hubble Telescope and the WMAP probe, is around 72 kilometres per second per megaparsec. (It should perhaps be pointed out that the Hubble constant is technically a parameter, not a constant, because it will actually change over long periods of time.)

This expansion, usually referred to as the "metric expansion" of space, is a "broad-brush effect" in that individual galaxies themselves are not expanding, but the clusters of galaxies into which the matter of the universe has become divided are becoming more widely separated and more thinly spread throughout space. Thus, the universe is not expanding "outwards" into pre-existing space; space itself is expanding, defined by the relative separation of parts of the universe. Returning to the image of the expanding universe as a balloon inflating, if tiny dots are painted on the balloon to represent galaxies, then as the balloon expands so the distance between the dots increases, and the further apart the dots the faster they move apart. Another analogy often used (and maybe even clearer) is that of a raisin cake expanding as it bakes, so that the raisins (galaxies) gradually all move away from each other.



Artists impression of the metric expansion of the universe

In such an expansion, then, the universe continues to look more or less the same from every galaxy, so the fact that we see all the galaxies receding from us does not necessarily mean that we are at the very centre of the universe: observers in all other galaxies would also see all the other galaxies flying away according to the same law, and the pattern of galactic dispersal would appear very much the same from anywhere in the cosmos.

The old model of a static universe, which had served since Sir Isaac Newton, was thus proved to be incontrovertibly false, but Hubble's discovery did more than just show that the universe was changing over time. If the galaxies were flying apart, then clearly, at some earlier time, the universe was smaller than at present. Following back logically, like a movie played in reverse, it must ultimately have had some beginning when it was very tiny indeed, an idea which gave rise to the theory of the Big Bang. Although now almost universally accepted, everyone did not immediately welcome this theory of the beginnings of the universe, and several strands of corroborating evidence were needed, as we will see in the following sections.

In the face of Hubble's evidence, Einstein was also forced to abandon his idea of a force of cosmic repulsion, calling it the "biggest blunder" he had ever made. But others, notably the Russian physicist Alexander Friedmann and the Belgian priest and physicist Georges Lemaître, had already used Einstein's own theory of prove that the universe was in fact in motion, either contracting or expanding. It is now recognized that Einstein's description of gravity as the curvature of space-time in his General Theory of Relativity was actually one of the first indications of a universe which had grown out of much humbler beginnings.

And, as we will see later, Einstein's "biggest blunder" may actually turn out to have been one of his most prescient predictions.

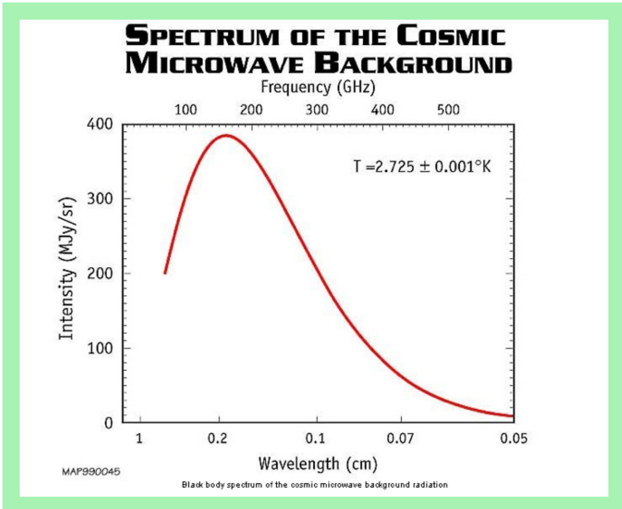
Cosmic Background Radiation

The Ukrainian- use American physicist George Gamow was the first to realize that, because the universe is all there is, the huge heat from a hot Big Bang could not dissipate in the same way as the heat from a regular explosion and therefore it must still be around today.

Gamow's research students, Ralph Alpher and Robert Herman, moreover, argued in 1948 that, because the Big Bang effectively happened everywhere simultaneously, that energy should be equally spread as cosmic microwave background radiation (or CMB for short) throughout the universe.

This radiation was emitted approximately 300,000 years after the Big Bang, before which time space was so hot that protons and electrons existed only as free ions, making the universe opaque to radiation. It should be visible today because, after this time, when temperatures fell to below about 3,000°K, ionized hydrogen and helium atoms were able to capture electrons, thus neutralizing their electric charge (known as "recombination"), and the universe finally became transparent to light.

In 1965, Arno Penzias and Robert Wilson, two young employees at Bell Telephone Laboratories in New Jersey, discovered, albeit by accident, just this. The mysterious microwave static they picked up on their microwave antenna seemed to be coming equally from every direction in the sky, and eventually they realized that this microwave radiation (which has a temperature of about -270°C, marginally above absolute zero, and the coldest thing found in nature) must indeed be the "after-glow" of the Big Bang. Penzias and Wilson received the 1978 Nobel Prize in Physics for their discovery (although, strangely, Gamow's contribution was never recognized).

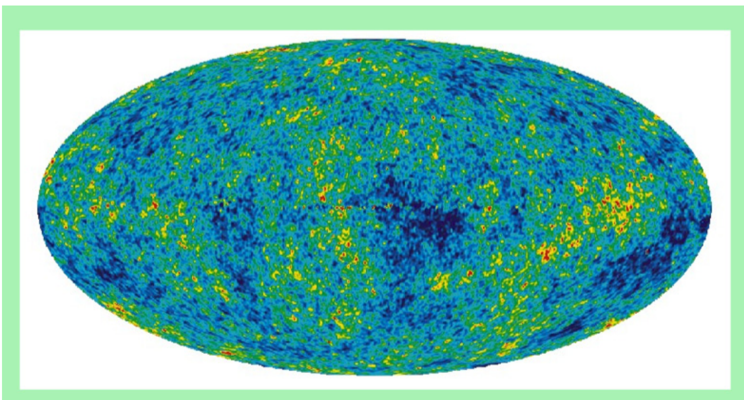


It was later confirmed that the intensity of these microwaves at different wavelengths traces out a "black body" or "thermal" curve, consistent with radiation that has been brought into balance with its environment - just what would be expected if they were indeed a relic of an early hot "fireball" stage. This discovery, perhaps the most important cosmological discovery since Edwin Hubble had shown that we live in an expanding universe, was powerful evidence that our universe had indeed begun in a hot, dense state and had been growing and cooling ever since.

The same photons that were around in the early stages of the Big Bang, then, have been propagating ever since, though growing fainter and less energetic as they fill a larger and larger universe. So ubiquitous is this cosmic microwave background radiation that, even though each cubic centimetre contains just 300 photons of it, in total it makes up 99% of all the photons in the universe (the remaining 1% being in starlight). It has been estimated that 1% of the "snow" which appears on a TV screen tuned between stations is attributable to cosmic background radiation!

In view of the importance of cosmic microwave background radiation to the Big Bang model of the universe (no other model has explained CMB quite so neatly), efforts were redoubled in an attempt to definitively prove the connection, first in the form of the Cosmic Background Explorer (COBE) satellite in 1989, and then the Wilkinson Microwave Anisotropy Probe (WMAP) in 2001. Both probes have confirmed the predicted data with increasing accuracy, as well as providing the most detailed picture we have of how the universe looked soon after the Big Bang, and establishing the age of the universe with much greater accuracy at 13.7 billion years.

Another indirect indication that the universe began with a Big Bang is wrapped up in the very fact that the night sky we see from Earth is black. Olbers' Paradox, named after the 19th Century German astronomer, Heinrich Wilhelm Olbers, who was one of the first to start to think of the universe as a whole. Olbers (who definitively stated the problem in 1823, although several others, dating back to the time of Newton, had previously posed similar ideas in various ways) asked why, if the universe was studded with billion upon billions of stars, the night sky was not completely lit up with the light from all these stars.



The answer (first pointed out, interestingly enough, by the author Edgar Allen Poe in 1848) lies in the fact that the light from the more distant stars, in fact from the majority of the objects in the universe, has still to reach us. The only stars and galaxies we see are those close enough that their light has taken less than the 13.7 billion years since the Big Bang to reach us. For the same reason, the most distant objects visible (those recorded with sensitive equipment like the Hubble Space Telescope) appear to consist of much younger galaxies, only recently formed, or consisting mainly of glowing diffuse gas not yet fragmented into stars.

Another apparent paradox is the question of why, given that the universe started off as much hotter than the centre of the hottest star, all the primordial nuclei of hydrogen were not instantly transmuted into the tightly-bound and ultra-stable nuclei of iron (the final state of fusion process). In that case, no long-lived stars could ever have existed in our present universe as all the available fuel would have been used up in the initial fireball, and the universe as we know it would have been a non-starter. In fact, the ultra-hot conditions of the first few minutes of the expansion only lasted long enough to turn about 23% of the hydrogen into helium and tiny traces of lithium. It turns out that even the oldest objects in the universe contain about 23-24% of helium, and this confirms calculations which predict that hydrogen and helium are the only elements which would be created prolifically in a Big Bang event.

Dark Matter

The simple Big Bang theory is, however, not without its potential problems, and some aspects require further investigation and explanation. One such problem is the rather unfortunate fact that about 85-95% of the matter, which is predicted, to exist in the universe appears to be invisible or otherwise unaccounted for!

The evenness of the cosmic microwave background radiation (the afterglow of the initial Big Bang) suggests that the matter emitted from the Big Bang should have been spread around very smoothly. But we know that the universe is in fact clumpy, with clusters of galaxies and great voids of empty space in between. Actually, in 1992, NASA's Cosmic Background Explorer (COBE) satellite did discover some variations or ripples in the brightness of the afterglow, which probably resulted from a period about 450,000 years after the Big Bang, when some parts of the universe became just a few thousandths of a per cent denser than others. These barely noticeable clumps of matter grew to become bigger clumps due to the cumulative effects of gravity, and the denser regions (the "seeds" of structure) became ever denser over time, leading to the great clusters of galaxies we see today.

However, the modelling of this theory revealed that the 13.7 billion years which has elapsed since the Big Bang is actually nowhere near long enough for the huge structures of today's universe to have developed, by the gradual process of gravity and increasing density, out of the tiny imperfections and clumps indicated by the COBE satellite. This could only have happened if there was, and/or is, much more matter in the universe than our current estimates of the matter tied up in visible stars. This has led to speculation about so-called "dark matter", an unknown substance which emits no light, heat, radio waves, nor any other kind of radiation (thus making extremely hard to detect).

The idea of dark matter, though, goes back much further than that. The stars in spiral galaxies like our own Milky Way whirl about the galactic centre, prevented from flying off into intergalactic space by gravity. However, calculations of the speed of the whirling, dating back to work by maverick astronomer Fritz Zwicky in the 1930s, suggest that the galaxy is actually spinning much faster than it theoretically should be in order to maintain its current equilibrium. Zwicky hypothesized that the only way this could occur was if galaxies, ours and all the others, actually contained much more matter (he estimated at least ten times as much) as is visible in stars, spread reasonably evenly throughout the galaxy.

Zwicky's observations were backed up by more accurate data gathered by Vera Rubin in the 1960s, and by Jim Peebles and Jerry Ostricker in the 1970s. Rubin noted that stars right out near the edge of the galaxy were orbiting around the galactic centre at the same speed as stars much closer in, whereas in our solar system, for example, the innermost planets orbit much faster than those further out. (Other more recent studies have shown that even hydrogen gas out on the fringes of the galaxy is still orbiting just as fast as the inner stars). It therefore appeared as though the force of gravity did NOT get weaker the further a star was from the centre of the galaxy, which flew in the face of all that was known about gravity. The only explanation was that some unseen and undetected mass (i.e. dark matter) was causing the increased rotation.

Thus, it appears that around 85% of the mass making up galaxies must be composed of an unknown, invisible substance, which came to be known as dark matter. This is almost exactly the factor of additional matter required by the models to allow the structures we see in today's universe to have developed from the ripples in the cosmic microwave background radiation discovered by the COBE satellite, as mentioned above. This dark matter makes up an even greater proportion of the small dwarf galaxies that can be found orbiting larger galaxies, including our own, and the same thing also applies on a larger scale to entire clusters of galaxies, millions of light years across, which would also need to contain many more times more material than we can see in order to hold together.

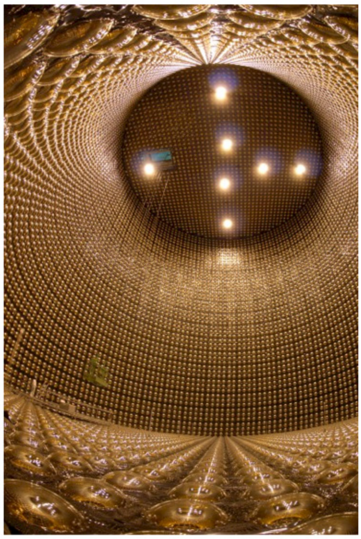
Ring of dark matter in the galaxy cluster Cl 0024+17

More recent studies, using modern gravitational lensing techniques, have added further confirmations, if any were needed, and have allowed the creation of a kind of "map" of dark matter which shows how galaxies and clusters of stars tend to form around, and within, the largest blobs of dark matter, which forms a kind of all-pervading halo around the visible objects of the universe. In this way, Carlos Frenk has produced a dramatic 3D simulation of the dark matter throughout the whole visible universe, showing what he calls the "skeleton" of the universe, or the "scaffolding" around which galaxies and clusters of galaxies have formed. It seems that everything we know is ultimately dependent on dark matter - without dark matter there would be no galaxies; without galaxies there would be no stars; without stars there would be no planets, and therefore no life.

The problem is that dark matter, whatever it may be, is invisible and extremely hard to detect. It is affected by gravity, but not by any of the other fundamental forces; it has no electrical charge; it does not seem to stick or clump together but floats freely; and it passes through atoms of normal matter without any kind of interference we can detect. In fact, it appears not even to interact with itself: colliding galaxies have been observed, where the normal matter of the two galaxies re-coalesces together as expected, but the dark matter just keep on going along its original path regardless. Its existence and properties can only be inferred from its gravitational effects on visible matter, radiation, and the large-scale structure of the universe.

So, despite its apparent ubiquity, no-one really knows what dark matter is, and astronomers are using a variety of technique, including gravitational lensing, to try to spot where such matter might lie. Among the possible candidates are so-called MACHOs (short for MAssive Compact Halo Objects), such as small brown and black dwarf stars, cold unattached planets, comet-like lumps of frozen hydrogen, tiny black holes, and possibly even mini dark galaxies. Other candidates for baryonic dark matter include cold and warm gas, bound to galaxy groups, but too cool to be visible or even detectable.

Scientists are also investigating other kinds of non-baryonic exotic particles, including WIMPs (short for Weakly Interacting Massive Particles), hypothetical super-symmetrical particles which may be all around us but which pass through normal matter without stopping and without interacting in any way. Experiments to look for WIMPs are being carried out in highly-shielded, super-cooled facilities deep down in rocky mines where other interfering cosmic rays cannot penetrate.



Super-Kamiokande, a neutrino observatory in the city of Hida, Gifu Prefecture, Japan

Another category of non-baryonic exotic particle, neutrinos, may represent another possibility. Neutrinos are tiny elementary particles which have no electric charge and hardly interact at all with ordinary atoms, and which mysteriously may even move faster than the speed of light. It is hypothesized that they could have come into existence during the first second after the Big Bang as part of the reaction with the photons that were created at that time, and it is calculated that there could be hundreds of millions of them for every atom in the universe, with millions of them passing through you and I and everything around us every second. So, even if each neutrino weighed a hundred-millionth as much as an atom, they could theoretically still be the dominant, if unseen, matter in the universe.

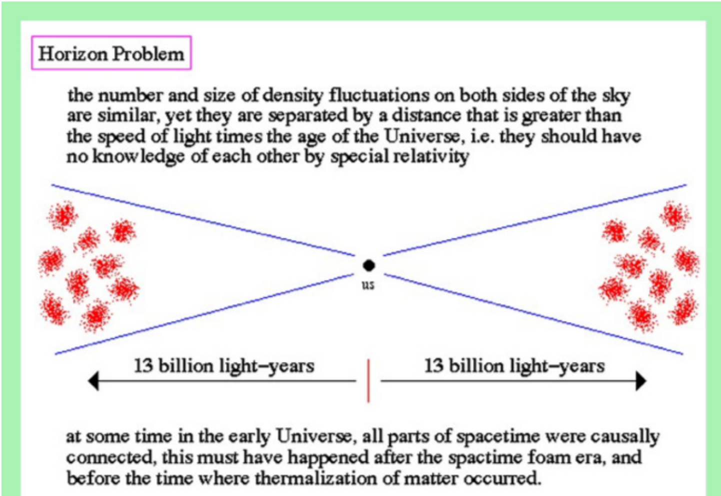
Cosmic Inflation

Another conundrum thrown up by the basic Big Bang theory is how to explain the relative homogeneity and evenness of the temperature of the cosmic microwave background radiation. How did large-scale structures such as galaxies and clusters of galaxies develop out of what should have been a rather boringly amorphous and featureless fireball?

This would appear to be in direct violation of the Second Law of Thermodynamics, which describes an inexorable tendency towards entropy and uniformity and away from patterns and structures. If our universe had started out completely smooth, then it should have continued that way, and the universe today would contain nothing more than thinly spread dark matter along with less than one atom per cubic meter of hydrogen and helium gas, with no sign of the texture and complexity we see around us (stars, galaxies, a multitude of elements, life).

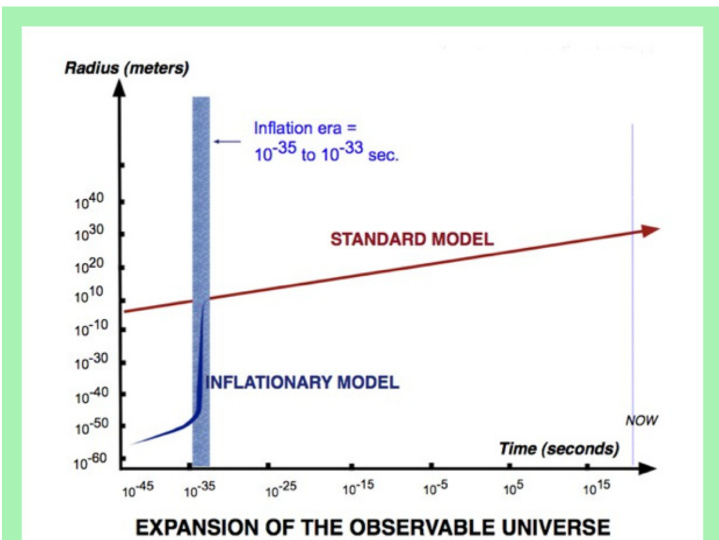
However, even very slight irregularities in the early phases of expansion would have become amplified as slightly dense patches are affected by additional gravity until they condensed into self-contained structures held together by their own gravity. Galaxies crashed and merged and cannibalised their neighbours, and larger scale structures like clusters and super-clusters formed by a continuing process of gravitational aggregation working on these newly formed galaxies.

Heat tends to travel from a hot body to a cold one so that the temperatures of both bodies eventually even out (a result of the Second Law of Thermodynamics itself), like hot coffee in a cold cup. The microwave background radiation discovered by Arno Penzias and Robert Wilson in the 1960s appeared to be extremely uniform throughout the observable universe, with almost no variance. But if, as the evidence suggests, the last time the cosmic background radiation had any contact with matter was about 450,000 years after the Big Bang (by which time the universe had cooled to around 3,000°C), then this presents a paradox, because the universe at that time would already have had a diameter of around 90 million light years, and just not enough time would have elapsed for radiation or heat to have flown around the whole universe and equalized itself, and the horizons could never have actually been in causal contact with each other (known as the "horizon problem").



The horizon problem of the Big Bang model

So, in theory, there actually ought to be even more variation today than there is. That is, unless the very early universe was in fact much smaller than the models were predicting. The most widely accepted theory as to how this might have been possible is known as cosmic inflation, which was first proposed in 1980 by the American physicist Alan Guth, developed out of Steven Weinberg's Electro weak Theory and Grand Unified Theory.



Graph of the expansion of the observable universe with inflation

As we will see, the addition of inflation to the Big Bang model claimed to solve the horizon problem, as well as one or two other potential problems that had been identified with the standard Big Bang theory, such as the "flatness problem" (why the density of matter in the universe appears "fine-tuned" to be very close to the critical value at which space is perfectly flat rather than a non-Euclidean hyperbolic or spherical shape) and the "magnetic monopole problem" (why the magnetic monopoles which theory suggests should have been produced in the high temperatures of the early universe appear not to have persisted to the present day).

Cosmic inflation is the idea that the very early universe went through a period of accelerated, exponential expansion during the first 10^{-35} of a second before settling down to the more sedate rate of expansion we are still experiencing, so that all of the observable universe originated in a small (indeed, microscopic) causally-connected region.

Although the universe has been expanding since the initial Big Bang, inflation refers to the hypothesis that, for a very short time, the universe expanded at a sharply INCREASING rate, rather than at the decreasing rate it followed before inflation and has followed since. By some calculations, inflation increased the size of the universe by a factor of around 10^{26} during that tiny fraction (far less than a trillionth) of a second, expanding it from smaller than the size of a proton to about the size of a grapefruit.

Technically, the expansion during this period of inflation (and even the somewhat slower expansion which succeeded it) proceeded faster than the speed of light. To explain how this is possible (the speed of light being supposedly the maximum speed it is possible to travel), an analogy may help. If two airplanes are flying directly away from each other at their maximum speed of, say, 500 kilometres per hour, they are actually flying apart at 1,000 kilometres per hour even though neither individual plane is exceeding 500km per hour. Thus, "expansion", in terms of the expanding universe, is not the same thing as "travel".

It is still not clear to scientists, however, exactly what caused the inflationary phase, the best guess being some kind of a negative "vacuum energy density" (or positive "vacuum pressure") triggered by the separation of the strong nuclear force from the other elementary forces at this time. It is hypothesized that this separation caused a kind of symmetry breaking or phase transition (analogous to the phase transition when water turns to ice), which left the universe in a highly unstable state with much more energy than it would otherwise have had, causing a sharp outward anti gravitational effect, smoothing out most of the irregularities in the existing matter and creating vast quantities of particles in a very short time.

This theory allows for some kind of very slight unevenness (so-called quantum fluctuations) on a sub-atomic scale at a very early stage in the growth of the universe, which provided starting points for the large-scale structures we see in today's universe. This suggests the rather bizarre possibility that sub-microscopic seeds may actually have spawned the largest structures in the universe, the great clusters of galaxies.

Guth hypothesized that the reason why the universe appears to be flat is because it is actually fantastically big (in the same way that the spherical Earth appears flat to those on its surface), and that the observable universe is actually only a very small part of the actual universe. In fact, Guth's calculations suggest that the entire universe may be at least 10^{23} times bigger than the size of the observable universe (the part within the horizon, that we are able, at least in principle, to see), roughly equal to the ratio of the size of the observable universe to the planet Earth. Thus, although the observable universe may appear to be effectively flat, the entire universe may be completely different in nature. Also, although an enormous number of magnetic monopoles could well have arisen in the inflationary early universe, the chances of actually observing even one magnetic monopole are infinitesimally small in a universe of such immense size.

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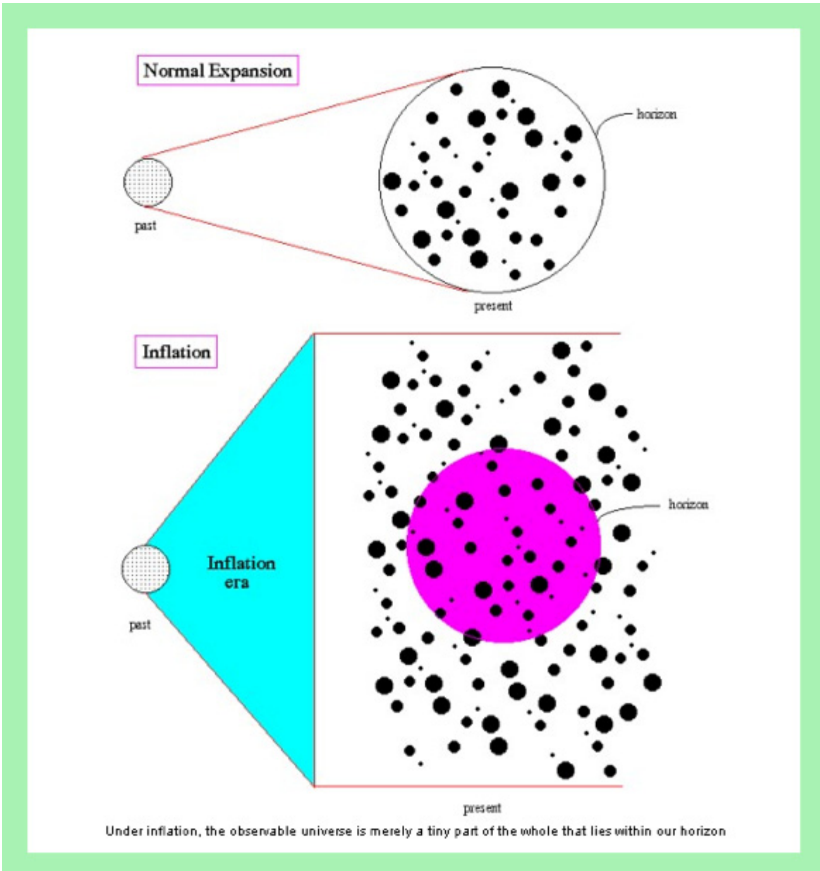
Thus, the incredibly vast and fast expansion of the universe caused by inflation "solved" both Robert Dicke flatness problem and Guth's own monopole problem. But it also solved the horizon problem: according to the inflation theory, the universe blew up so quickly that there was no time for the essential homogeneity to be broken, and the universe after inflation would therefore have been very uniform, even though the parts of it were not still in touch with each other.



In an attempt to prove the inflation theory, the Cosmic Background Explorer (COBE) probe was launched in 1992, and its initial results confirmed almost exactly the amount of variation in the cosmic microwave background radiation that was predicted by inflationary theory. In 2003, the Wilkinson Microwave Anisotropy Probe (WMAP) demonstrated the existence of these non-uniformities with even greater precision. As recently as 2014, astronomers at the Harvard-Smithsonian Centre for Astrophysics announced that they had detected and mapped "gravitational waves" within the cosmic microwave background radiation, providing further strong evidence for inflation (and for the Big Bang itself), although further peer review of these new findings are still ongoing.

Guth's theory has been very influential, even if he himself could find no way to end inflation so that stars and galaxies could form (known the "graceful exit" problem), and he considered his own theory something of a failure because of this. There have been many other refinements and revisions since Guth's original model, such as the "new inflationary model" of Russian physicist Andrei Linde, who had been working on an inflation theory independently (as had Paul Steinhardt and Andreas Albrecht). This new model hypothesized a slow (as opposed to Guth's fast) breaking of symmetry, and the creation of many "bubble universes" (just one of which contains our own observable universe). A later proposal by Linde, known as the "chaotic inflationary model", hypothesized that a "spin-0 field" rather than any kind of phase transition caused the repulsive antigravity effect as Guth had thought.

Linde's work, and that of fellow Russian Alex Vilenkin, has also given rise to the idea of "eternal inflation", where the inflation as a whole actually never stops, but small localized energy discharges within the overall energy field - almost like sparks of static electricity, but on a cosmic scale - create small points of matter in the form of tiny particles. Such a process may represent the birth of a new universe, such as our own. Beginning in this way with what we have called a Big Bang, this new universe then itself proceeds to expand, although at a much slower rate than the continuing inflation outside of it. The rest of space outside of that universe is still full of undercharged energy, still expanding at enormous speed, and new universes, new Big Bangs, are occurring all the time.

The theory of cosmic inflation, then, supports the scenario in which our universe is just one among many parallel universes in a multiverse. As we will see in later sections, some corroborating evidence for such a scenario also arises from work on dark energy, on super string theory and on quantum theory. However, the idea of a hypothetical multiverse, which we can never see or prove, is anathema to many physicists, and many critics still remain.

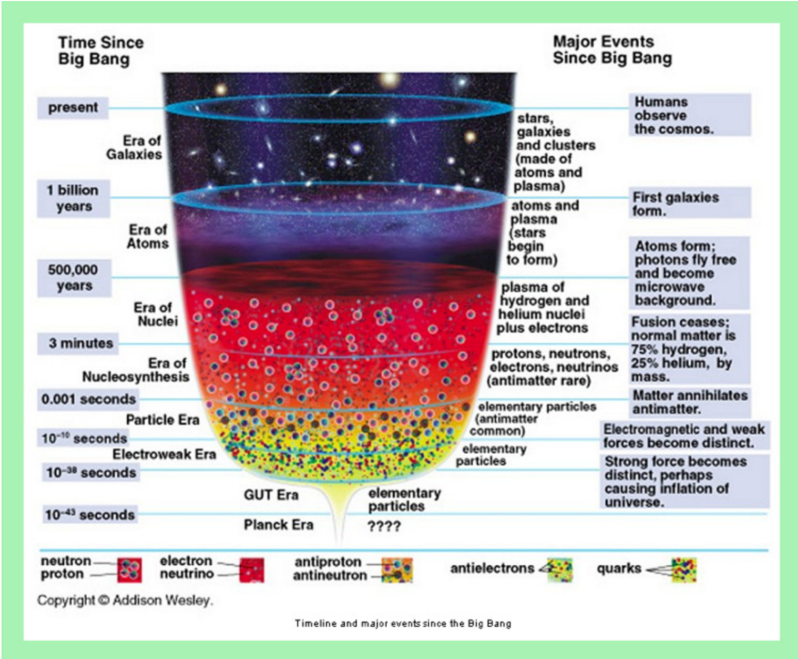
Timeline of the Big Bang

Since the Big Bang, 13.7 billion years ago, the universe has passed through many different phases or epochs. Due to the extreme conditions and the violence of its very early stages, it arguably saw more activity and change during the first second than in all the billions of years since.

From our current understanding of how the Big Bang might have progressed, taking into account theories about inflation, Grand Unification, etc, we can put together an approximate timeline as follows:

- Planck Epoch (or Planck Era), from zero to approximately 10^{-43}seconds (1 Planck Time):This is the closest that current physics can get to the absolute beginning of time, and very little can be known about this period. General relativity proposes a gravitational singularity before this time (although even that may break down due to quantum effects), and it is hypothesized that the four fundamental forces (electromagnetism, weak nuclear force, strong nuclear force and gravity) all have the same strength, and are possibly even unified into one fundamental force, held together by a perfect symmetry which some have likened to a sharpened pencil standing on its point (i.e. too symmetrical to last). At this point, the universe spans a region of only 10^{-35} meters (1 Planck Length), and has a temperature of over 10^{32}°C (the Planck Temperature).
- Grand Unification Epoch, from 10^{-43} seconds to 10^{-36} seconds: The force of gravity separates from the other fundamental forces (which remain unified), and the earliest elementary particles (and antiparticles) begin to be created.

- Inflationary Epoch, from 10^{-36} seconds to 10^{-32} seconds: Triggered by the separation of the strong nuclear force, the universe undergoes an extremely rapid exponential expansion, known as cosmic inflation. The linear dimensions of the early universe increases during this period of a tiny fraction of a second by a factor of at least 10^{26} to around 10 centimetres (about the size of a grapefruit). The elementary particles remaining from the Grand Unification Epoch (a hot, dense quark-gluon plasma, sometimes known as "quark soup") become distributed very thinly across the universe.
- Electro weak Epoch, from 10^{-36} seconds to 10^{-12} seconds: As the strong nuclear force separates from the other two, particle interactions create large numbers of exotic particles, including W and Z bosons and Higgs bosons (the Higgs field slows particles down and confers mass on them, allowing a universe made entirely out of radiation to support things that have mass).
- Quark Epoch, from 10^{-12} seconds to 10^{-6} seconds: Quarks, electrons and neutrinos form in large numbers as the universe cools off to below 10 quadrillion degrees, and the four fundamental forces assume their present forms. Quarks and anti quarks annihilate each other upon contact, but, in a process known as baryogenesis, a surplus of quarks (about one for every billion pairs) survives, which will ultimately combine to form matter.
- Hadron Epoch, from 10^{-6} seconds to 1 second: The temperature of the universe cools to about a trillion degrees, cool enough to allow quarks to combine to form hadrons (like protons and neutrons).Electrons colliding with protons in the extreme conditions of the Hadron Epoch fuse to form neutrons and give off mass-less neutrinos, which continue to travel freely through space today, at or near to the speed of light. Some neutrons and neutrinos re-combine into new proton-electron pairs. The only rules governing all this apparently random combining and re-combining are that the overall charge and energy (including mass-energy) be conserved.

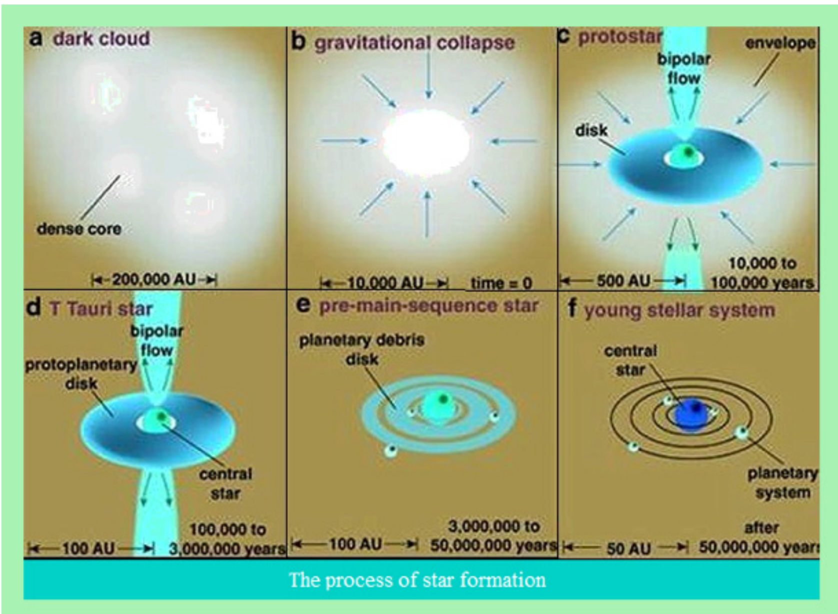


Timeline and major events since the Big Bang

- Lepton Epoch, from 1 second to 3 minutes: After the majority (but not all) of hadrons and anti hadrons annihilate each other at the end of the Hadron Epoch, leptons (such as electrons) and anti leptons (such as positrons) dominate the mass of the universe. As electrons and positrons collide and annihilate each other, energy in the form of photons is freed up, and colliding photons in turn create more electron-positron pairs. Nucleo synthesis, from 3 minutes to 20 minutes: The temperature of the universe falls to the point (about a billion degrees) where atomic nuclei can begin to form as protons and neutrons combine through nuclear fusion to form the nuclei of the simple elements of hydrogen, helium and lithium. After about 20 minutes, the temperature and density of the universe has fallen to the point where nuclear fusion cannot continue.
- Photon Epoch (or Radiation Domination), from 3 minutes to 240,000 years: During this long period of gradual cooling, the universe is filled with plasma, a hot, opaque soup of atomic nuclei and electrons. After most of the leptons and anti leptons had annihilated each other at the end of the Lepton Epoch, the energy of the universe is dominated by photons, which continue to interact frequently with the charged protons, electrons and nuclei.

- Recombination/Decoupling, from 240,000 to 300,000 years: As the temperature of the universe falls to around 3,000 degrees (about the same heat as the surface of the Sun) and its density also continues to fall, ionized hydrogen and helium atoms capture electrons (known as "recombination"), thus neutralizing their electric charge. With the electrons now bound to atoms, the universe finally becomes transparent to light, making this the earliest epoch observable today. It also releases the photons in the universe which have up till this time been interacting with electrons and protons in an opaque photon-baryon fluid (known as "decoupling"), and these photons (the same ones we see in today's cosmic background radiation) can now travel freely. By the end of this period, the universe consists of a fog of about 75% hydrogen and 25% helium, with just traces of lithium.
- Dark Age (or Dark Era), from 300,000 to 150 million years: The period after the formation of the first atoms and before the first stars is sometimes referred to as the Dark Age. Although photons exist, the universe at this time is literally dark, with no stars having formed to give off light. With only very diffuse matter remaining, activity in the universe has tailed off dramatically, with very low energy levels and very large time scales. Little of note happens during this period, and mysterious "dark matter" dominates the universe.
- Reionization, 150 million to 1 billion years: The first quasars form from gravitational collapse, and the intense radiation they emit reionizes the surrounding universe, the second of two major phase changes of hydrogen gas in the universe (the first being the Recombination period). From this point on, most of the universe goes from being neutral back to being composed of ionized plasma.
- Star and Galaxy Formation, 300 - 500 million years onwards: Gravity amplifies slight irregularities in the density of the primordial gas and pockets of gas become more and more dense, even as the

universe continues to expand rapidly. These small, dense clouds of cosmic gas start to collapse under their own gravity, becoming hot enough to trigger nuclear fusion reactions between hydrogen atoms, creating the very first stars. The first stars are short-lived super massive stars, a hundred or so times the mass of our Sun, known as Population III (or "metal-free") stars. Eventually Population II and then Population I stars also begin to form from the material from previous rounds of star-making. Larger stars burn out quickly and explode in massive supernova events, their ashes going to form subsequent generations of stars. Large volumes of matter collapse to form galaxies and gravitational attraction pulls galaxies towards each other to form groups, clusters and super clusters.



The process of star formation

- Solar System Formation, 8.5 - 9 billion years: Our Sun is a late-generation star, incorporating the debris from many generations of earlier stars, and it and the Solar System around it form roughly 4.5 to 5 billion years ago (8.5 to 9 billion years after the Big Bang).
- Today, 13.7 billion years: The expansion of the universe and recycling of star materials into new stars continues.

Accelerating Universe and the Dark Energy

Like dark matter, cosmic inflation (even if it is not actually proven beyond all doubt) is now usually seen as part of the standard Big Bang theory, and to some extent the two additional concepts rescue the Big Bang theory from being completely untenable. However, other potential problems still remain.

The universe has continued to expand since the Big Bang, albeit at a slower rate since the period of inflation, while at the same time the gravity of all the matter in the universe is working to slow down and eventually reverse the expansion. Two main possibilities therefore present themselves: either the universe contains sufficient matter (known as the "critical mass") for its gravity to reverse the expansion, causing the universe to collapse back to what has become known as the “Big Crunch”, a kind of mirror image of the initial Big Bang; or it contains insufficient matter and it will go on expanding forever.

According to General Relativity, the density parameter, Omega, which is defined as the average density of the universe divided by the critical density (i.e. that required for the universe to have zero curvature) is related to the curvature of space. If Omega equals 1, then the curvature is zero and the universe is flat; if Omega is greater than 1, then there is positive curvature, indicating a closed or spherical universe; if Omega is less than 1, then there is negative curvature, suggesting an open or saddle-shaped universe.

The cosmic inflation model hypothesizes an Omega of exactly 1, so that the universe is in fact balanced on a knife’s edge between the two extreme possibilities. In that case, it will continue expanding, but gradually slowing down all the time, finally running out of steam only in the infinite future. For this to occur, though, the universe must contain exactly the critical mass of matter, which current calculations suggest should be about five atoms per cubic metre (equivalent to about $5 \times 10^{-30} g/cm^3$).

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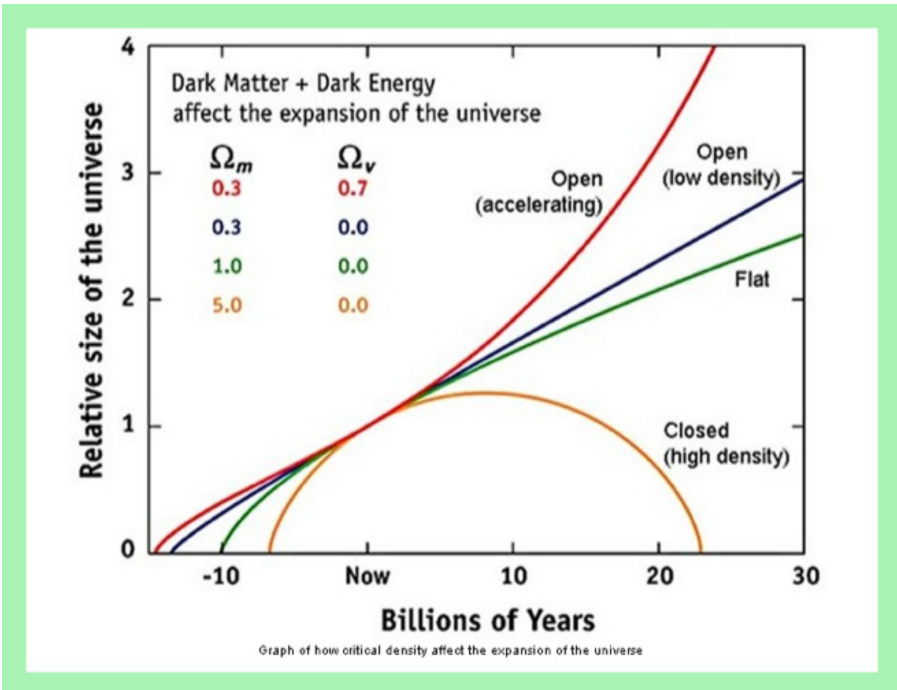
This perhaps sounds like a tiny amount (indeed it is much closer to a perfect vacuum than has even been achieved by scientists on Earth), but the actual universe is, on average, much emptier still, with around 0.2 atoms per cubic meter, taking into account visible stars and diffuse gas between galaxies. Even including dark matter in the calculations, all the matter in the universe, both visible and dark, only amounts to about a quarter of the required critical mass, suggesting a continuously expanding universe.

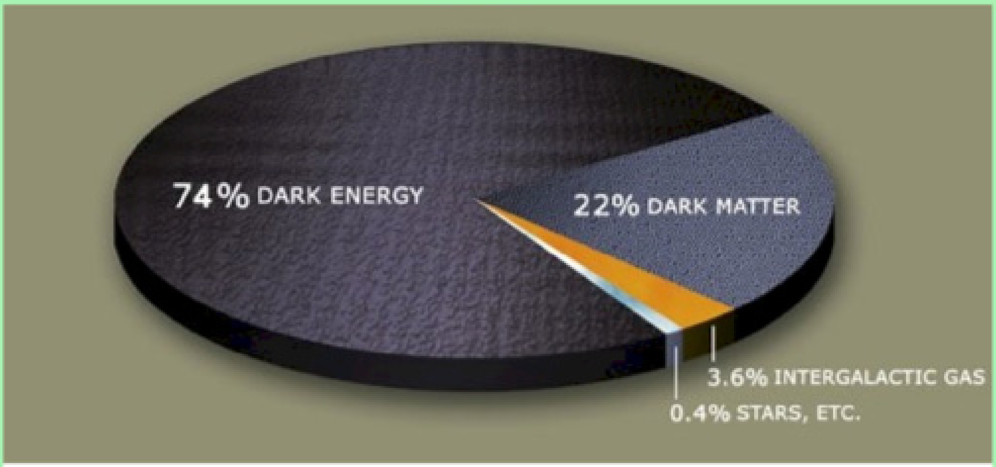


Graph of how critical density affect the expansion of the universe

However, in 1998, two separate teams of astronomers observing distant type 1a supernovas (one led by the American Saul Perlmutter and the other by the Australians Nick Suntzeff and Brian Schmidt) made parallel discoveries which threw the scientific community into disarray, and which also has important implications for the expanding universe and its critical mass. The faintness of the supernova explosions seemed to indicate that they were actually further away from the Earth than had been expected, suggesting that the universe's expansion had actually speeded up (not slowed) since the stars exploded. Contrary to all expectations, therefore, the expansion of the universe actually seems to be significantly speeding up - we live in an accelerating universe!

The only thing that could be accelerating the expansion (i.e. more than countering the braking force of the mutual gravitational pull of the galaxies) is space itself, suggesting that perhaps it is not empty after all but contains some strange "dark energy" or "antigravity" currently unknown to science. Thus, even what appears to be a complete vacuum actually contains energy in some currently unknown way. In fact, initial calculations (backed up by more recent research such as that on the growth of galaxy clusters by NASA's Chandra x-ray space telescope and that on binary galaxies by Christian Marinoni and Adeline Buzzi of the University of Provence) suggest that fully 73 - 74% of the universe consists of this dark energy.

If 74% of the total mass of the universe consists of dark energy, and about 26% of the remaining actual matter (representing about 22% of the total) is dark matter (see the section on Dark Matter for more discussion of this), then this suggests that only around 4% of the universe consists of what we think of as "normal", everyday, atom-based matter such as stars, intergalactic gas, etc. As of 2013, based on cosmic microwave background radiation data from the Planck satellite, the latest figures are closer to 68%, 27% and 5% respectively. Nowadays, this is generally accepted as the "standard model" of the make-up of the universe. So, for all our advances in physics and astronomy, it appears that we can still only see, account for and explain a small proportion of the totality of the universe, a sobering thought indeed.



Estimated distribution of dark energy, dark matter and normal matter in the universe

Incorporating dark energy into our model of the universe would neatly account for the "missing" three-quarters of the universe required to cause the observed acceleration in the revised Big Bang theory. It also makes the map of the early universe produced by the WMAP probe fit well with the currently observed universe. Carlos Frenk's beautiful 3D computer models of the universe resemble remarkably closely the actual observed forms in the real universe (taking dark matter and dark energy into account), even if they convince not all scientists. Alternative theories, such as Mordehai Milgrom's idea of "variable gravity", are as yet poorly developed and would have the effect of radically modifying all of physics from Newton onwards. So dark energy remains the most widely accepted option.

Further corroboration of some kind of energy operating in the apparent vacuum of space comes from the Casimir effect, named after the 1948 experiments of Dutch physicists Hendrik Casimir and Dirk Polder. This shows how smooth uncharged metallic plates can move due to energy fluctuations in the vacuum of empty space, and it is hypothesized that dark energy, generated somehow by space itself, may be a similar kind of vacuum fluctuation.

Unfortunately, like dark matter, we still do not know exactly what this dark energy is, how it is generated or how it operates. It appears to produce some kind of a negative pressure, which is distributed relatively homogeneously in space, and thereby exerts a kind of cosmic repulsion on the universe, driving the galaxies ever further apart. As the space between the galaxies inexorably widens, the effects of dark energy appears to increase, suggesting that the universe is likely to continue expanding forever, although it seems to have little or no influence within the galaxies and clusters of galaxies themselves, where gravity is the dominant force.

Although no-one has any idea of what dark energy may actually be, it appears to be unsettlingly similar to the force of cosmic repulsion or "cosmological constant" discarded by Einstein back in 1929 (as mentioned in the section on The Expanding Universe and Hubble's Law), and this remains the most likely contender, even if its specific properties and effects are still under intense discussion. The size of the cosmological constant needed to describe the accelerating expansion of our current universe is very small indeed, around 10^{-122} in Planck units. Indeed, the very closeness of this to zero (without it actually being zero) has worried many scientists. But even a tiny change to this value would result in a very different universe indeed, and one in which life, and even the stars and galaxies we take for granted, could not have existed.

Perhaps equally worrying is the colossal mismatch between the infinitesimally small magnitude of dark energy, and the value predicted by quantum theory, our best theory of the very small, as to the energy present in apparently empty space. The theoretical value of dark energy is over 10^{120} times smaller than this, what some scientists have called the worst failure of a prediction in the history of science! Some scientists have taken some comfort about the unexpectedly small size of dark energy in the idea that ours is just one universe in an unimaginably huge multiverse. Out of a potentially infinite number of parallel universes, each with slightly different properties and dark energy profiles, it is not so unlikely that ours just happens to be one with a dark energy that allows for the development of stars and even life, an example of the anthropic principle.

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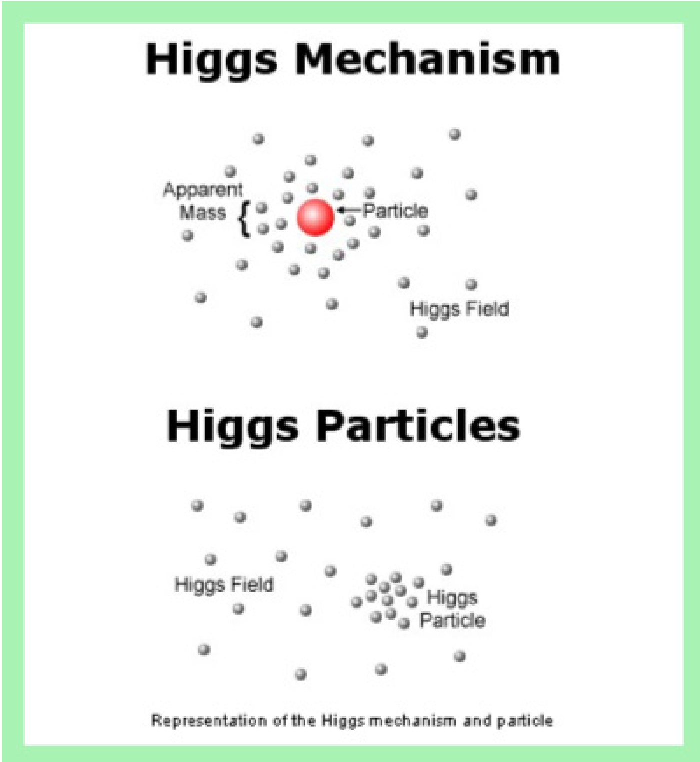


There has been some speculation that dark energy may be connected to the still little understood Higgs field. According to the theoretical work of the English physicist Peter Higgs and others in the 1960s, the vacuum of space is actually permeated by what has become known as a Higgs field. It is the interactions with this field that gives the other elementary particles their mass, as it stops them from flying off at the speed of light by clustering around them and impeding their progress.

Excitations of the Higgs field form particles known as Higgs bosons, an essential component of the current Standard Model of particle physics. Up until 2012, though, such a particle remained entirely theoretical and unproven. But experiments in 2012, at the Large Hadron Collider at CERN, were finally able to create and isolate a particle which gives every indication of being the elusive Higgs boson, although more detailed tests are still ongoing.

Another possible candidate for dark energy arises from the theoretical work on super symmetry, which effectively doubles the number of elementary particles in the current Standard Model with the postulation of massive unknown "super-partners" for each particle, whose spin differs by ½. Yet other candidates are so-called "quintessence" and so-called "phantom energy", although these ideas are essentially still at the hypothesis stage.

Neither is it clear whether the effects of dark energy are constant or changing over time, although research using data from the Hubble Space Telescope suggests that it was already at work boosting the expansion of the universe as much as nine billion years ago.

Antimatter

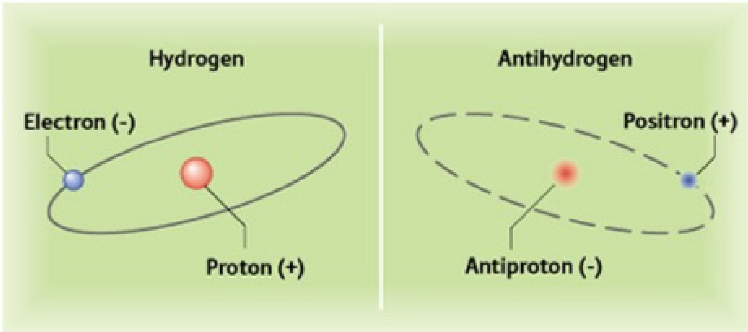
Another area, which perhaps needs some additional explanation, is the concept of antimatter, and why our universe consists almost entirely of matter and hardly any antimatter. According to theory, the Big Bang should have produced matter and antimatter in equal quantities. Thus, for every quark produced in the early stages of the Big Bang, there would also have been an anti quark; for every electron, a positron (the antiparticle of the electron); etc. The apparent asymmetry of matter and antimatter in the visible universe is one of the greatest unsolved problems in physics.

The British physicist Paul Dirac first predicted the existence of antimatter in 1928. For each of his theoretical equations, there appeared to exist another associated solution, with all the properties reversed, which did not seem to physically exist in the known universe. This antimatter, then, is the "mirror image" of matter, and the antiparticles of which it is composed are the mirror images of normal particles, being the same size but having opposite electrical charge.

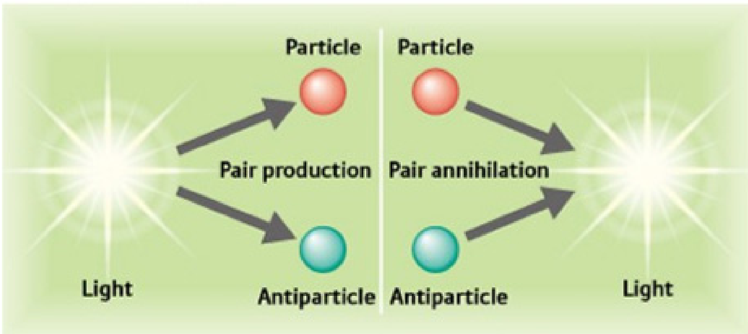
Dirac's equations also predicted that, if enough energy could be concentrated, an anti electron (always accompanied by an electron in order to preserve the overall electrical charge) could in theory be produced where none had existed before! In 1933, Carl Anderson successfully demonstrated the appearance of this hypothetical anti electron (which he called the positron), and definitively showed that matter could in fact be created in the laboratory in a controlled experiment. With the development of super-high-acceleration machines after World War II, other particles (such as protons and neutrons) and their respective antiparticles were created, and even stored in magnetic "bottles".

However, when matter and antimatter meet, they completely annihilate each other in a brilliant flash of light produced by extremely high-energy gamma photons. This explosive annihilation mirrors the huge energy required to produce the matter-antimatter pairs in the first place.

For example, the high-energy cosmic rays, which regularly impact the Earth's atmosphere, produce minute quantities of antimatter in the resulting particle jets, which are immediately annihilated by contact with nearby matter. The tiny quantities of antimatter, which scientists have managed to create in the laboratory, have always been accompanied by an equal quantity of normal matter, and the two tend to cancel each other out almost immediately. While it is technically possible that substantial amounts of antimatter do exist somewhere in the universe, isolated in some way from normal matter, no substantial quantities of antimatter have actually been discovered. Which begs the question of why this huge apparent imbalance exists, and why all matter and antimatter did not just annihilate each other completely very early in the history of the universe (and therefore, ultimately, why we are here at all!)



Antihydrogen consists of an antiproton with a negative charge and a positron with a positive charge.



Particle and antiparticle pairs are produced from light. Conversely, upon collision of a particle and an antiparticle, pair annihilation occurs to produce light. On annihilation of an antiproton and a proton or a neutron, several π-mesons are released in the first step.

Pair production and pair annihilation of hydrogen and antihydrogen particles

It is assumed that, very early in the life of the universe, in a process known as baryogenesis, massive numbers of particles and antiparticles were created and did in fact annihilate each other. The cosmic microwave background radiation, which pervades the universe today, represents the remains of the energy produced by this wholesale annihilation of the matched particle-antiparticle pairs. But a small imbalance remained, in the form of an excess of matter, of the order of one extra matter particle per billion matter-antimatter particle pairs. It has been calculated that this apparently tiny imbalance in the early universe would be sufficient to make up the amount of matter presently observable in the universe.

In 1966, the Russian physicist Andrei Sakharov outlined three conditions necessary for a matter-antimatter imbalance to be possible: first, protons must decay, but so slowly that for all the protons in the Earth, fewer than a bread crumb's worth should have decayed so far; second, there must be specific constraints on the way in which the universe has cooled after the Big Bang; and third, there must be a measurable difference between matter and antimatter.

James Cronin and Val Fitch won the Nobel Prize in the 1960s for their work on a particle called the kaon, which showed that particles and their antiparticles might not in fact be exact opposites, and it does seem possible that kaons might actually live longer than anti kaons, but it is still far from clear whether this could account for the triumph of matter over antimatter in the universe.

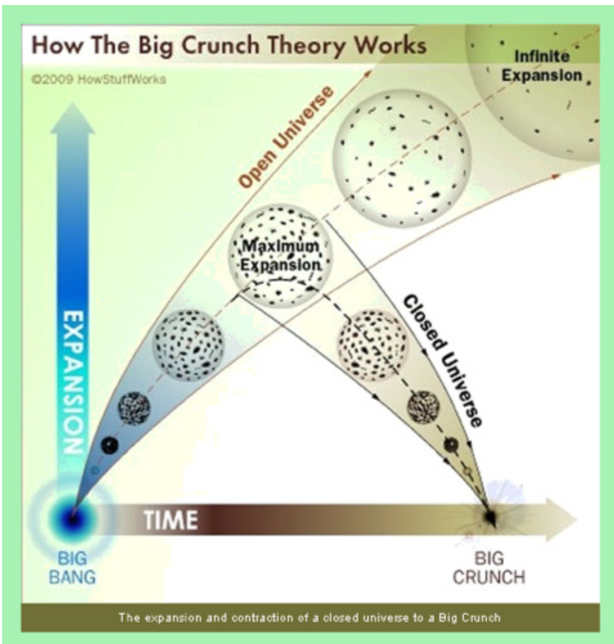
The Big Crunch, the Big Freeze and the Big Rip

Clearly, further advances in fundamental physics are required before it will be possible to know the ultimate fate of the universe with any level of certainty. However, scientists generally agree that this fate will depend on three things: the universe's overall shape or geometry, on how much dark energy it contains, and on the so-called "equation of state" (which essentially determines how the density of the dark energy responds to the expansion of the universe).

If the geometry of the universe is "closed" (like the surface of a sphere), then there are two main possibilities, as has been mentioned in the section on Accelerating Universe and Dark Energy. If the universe has a large amount of dark energy (as recent findings suggest it may well have), then the expansion of the universe could theoretically continue forever. If, however, the universe lacks the repulsive effect of dark energy, then gravity will eventually stop the expansion of the universe and it will start to contract until all the matter in the universe collapses to a final singularity, a mirror image of the Big Bang known as the "Big Crunch", somewhere in the region of a hundred billion years from now.

Models of a collapsing universe of this kind suggest that, at first, the universe would shrink more or less evenly, because, on a gross scale, matter is reasonably consistently distributed. At first, the rate of contraction would be slow, but the pace would gradually pick up. As the temperature begins to increase exponentially, stars would explode and vaporize, and eventually atoms and even nuclei would break apart in a reverse performance of the early stages after the Big Bang.

As the universe becomes compacted into a very small volume, any slight irregularities will become ever more magnified and, in the final stages, the collapse will probably be wildly chaotic, and gravity and the warping of space-time will vary immensely depending on the direction the singularity is approached by an in-falling body. According to some predictions, very close to the singularity, the warp age of space-time will become so violent and chaotic that space and time will actually "shatter" into "droplets" and all current concepts of time, distance and direction will become meaningless.



The expansion and contraction of a closed universe to a Big Crunch

This model offers intriguing possibilities of an oscillating or cyclic universe (or "Big Bounce"), where the Big Crunch is succeeded by the Big Bang of a new universe, and so on, potentially ad infinitum. However, in the light of recent findings in the 1990s (such as the evidence for an accelerating universe described previously), this is no longer considered the most likely outcome.

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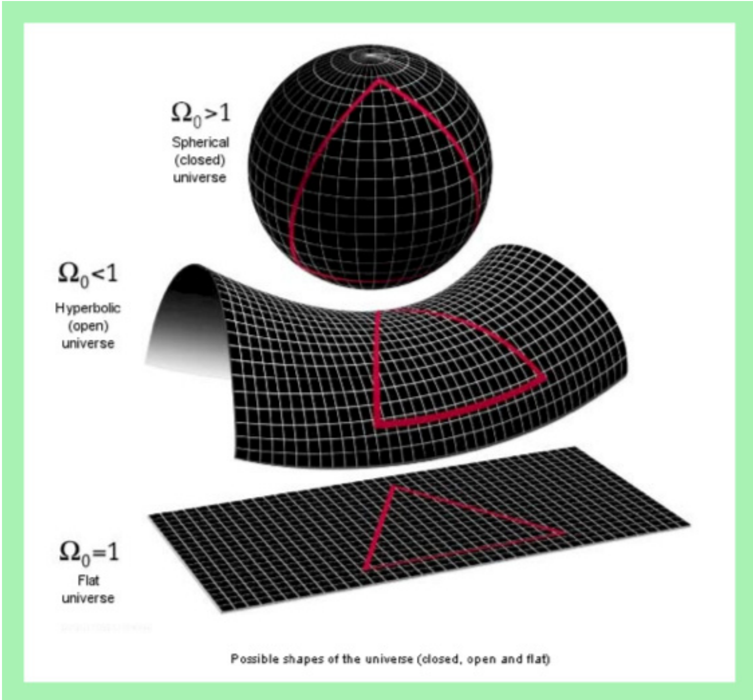


If, on the other hand, the geometry of space is "open" (negatively curved like the surface of a saddle), or even "flat", the possibilities are very different. Even without dark energy, a negatively curved universe would continue expanding forever, with gravity barely slowing the rate of expansion. With dark energy thrown into the equation, the expansion not only continues but also accelerates, and just how things develop depends on the properties of the dark energy itself, which remain largely unknown to us.

One possibility is where the acceleration caused by dark energy increases without limit, with the dark energy eventually becoming so strong that it completely overwhelms the effects of the gravitational, electromagnetic and weak nuclear forces. Known as the "Big Rip", this would result in galaxies, stars and eventually even atoms themselves being literally torn apart, with the universe as we know it ending dramatically in an unusual kind of gravitational singularity within the relatively short time horizon of just 35 - 50 billion years.

Perhaps the most likely possibility, however, based on current knowledge, is a long, slow decline known as the "Big Freeze" (or the “Big Chill” or “Heat Death”). In this scenario, the universe continues expanding and gradually “runs down” to a state of zero thermodynamic free energy in which it is unable to sustain motion or life. Eventually, over a time scale of 10^{14} (a hundred trillion) years or more, it would reach a state of maximum entropy at a temperature of very close to absolute zero, where the universe simply becomes too cold to sustain life, and all that would remain are burned-out stars, cold dead planets and black holes.

What happens after that is even more speculative but, eventually, even the atoms making up the remaining matter would start to degrade and disintegrate, as protons and neutrons decay into positrons and electrons, which over time would collide and annihilate each other. Depending on the rate of expansion of the universe at that time, it is possible that some electrons and positrons may form bizarre atoms billions of light years in size, known as positronium, with the distant particles orbiting around each other so slowly it would take a million years for them to move a single centimetre. After perhaps 10^{116} years, even the positronium will have collapsed and the particles annihilated each other.

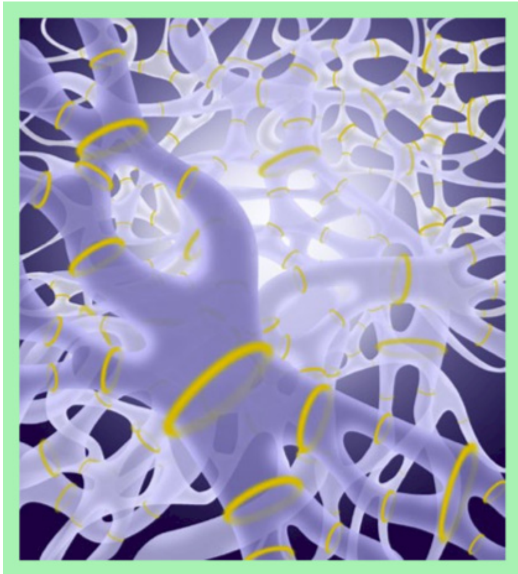
In this way, all matter would slowly evaporate away as a feeble energy, leaving only black holes, ever more widely dispersed as the universe continues to expand. The black holes themselves would break down eventually, slowly leaking away "Hawking radiation", until, after 10^{200} years, the universe will exist as just empty space and weak radiation at a temperature infinitesimally above absolute zero. At the end of the universe, time itself will lose all meaning, as there will be no events of any kind, and therefore no frame of reference to indicate the passage of time or even its direction.

Interestingly, recent analyses from the WMAP satellite and the Cosmic Background Imager, seem to be confirming other recent observations indicating that the universe is in fact flat (as opposed to closed or open). These experiments have revealed hot and cold spots with a size range of approximately one degree across, which, according to current theory, would be indicative of a flat universe.

To fully understand Superstrings and Quantum Gravity

To fully understand questions like where the universe came from, why the Big Bang occurred 13.7 billion years ago and what, if anything, existed before it, we need to better understand singularities like those in black holes and the singularity which marked the birth of the universe itself.

In order to achieve that, most scientists agree that a "quantum theory of gravity" (also known as "quantum gravity" or "unification" or the "theory of everything") is needed, which combines the General Theory of Relativity (our current best theory of the very large) and quantum theory (our current best theory of the very small). These may seem like fundamentally incompatible concepts, and even Einstein, who devoted most of the latter part of his life to unification, came up short. But attempts are nevertheless continuing on several fronts to find just such a synthesis.

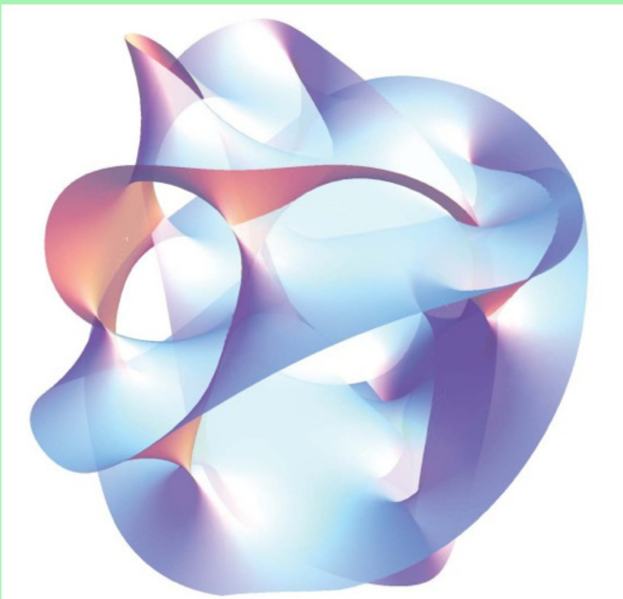


In the 1970s, the strongest candidate for a unified theory was probably “supergravity”, a field theory combining the principles of super symmetry and general relativity. But, although the approach appeared promising, it soon became apparent that the calculations involved were so long and difficult that it may never be provable. Around 1984, however, largely in response to a ground-breaking paper by Michael Green and John Schwarz, there was a remarkable change of opinion in the world of theoretical physics in favour of string theory (or, more specifically, Theory), a paradigm shift sometimes referred to as the "First Superstring Revolution".

Gabriele Veneziano, Leonard Susskind and others as a result of work had first been posited in the late 1960s the String theory. It views the basic building blocks of matter not as point-like particles but as unimaginably small one-dimensional vibrating “strings” of energy, which have length but no other dimension, like infinitely thin pieces of string or twine. A string may be open (i.e. have ends) or closed (i.e. joined up in loops), and the history of a string over time is represented by a two-dimensional strip (for open strings) or tube (for closed strings).

There might seem to be an inconsistency between the idea of a universe composed of strings and the point-like particles we actually observe in experiments. However, this is because the strings are so tiny that we cannot resolve their shape, even with our best technology, so that they just appear to us as tiny featureless points, like the difference between a speck of dust seen with the naked eye and under a microscope. To give some idea of the scales involved, a string is as small compared to an electron as a mouse is to the whole Solar System (around 20 order of magnitude smaller).

But the real beauty of string theory is that it looks on everything in the universe, all matter and all forces as well, as being made up of one single ingredient. Strings are composed of super-concentrated mass-energy which vibrate like a violin strings, with each distinct vibration mode corresponding to a fundamental particle (such as an electron or a photon, etc). The dividing or joining together of strings represents the emission or absorption of one particle by another, and the forces acting on particles correspond to other strings linking the particle strings in a complex "web".



3-D projection of a multi-dimensional Calabi-Yao manifold

According to string theory, then, the universe is a kind of symphony and the laws of physics are its harmonies. The vibrations of strings, however, occur in a ten-dimensional world, with each one-dimensional point in our ordinary space actually consisting of a complicated geometrical structure in six dimensions, all wrapped up on the scale of the Planck length (the smallest distance or size about which anything can be known, approximately 1.6×10^{-35} metres). The vibratory quality of these tiny threads of energy is what replaces particles and fields in the quantum description of the universe. The strength of the vibrations is what we see in the world as mass, and the patterns of vibrations are the fundamental forces.

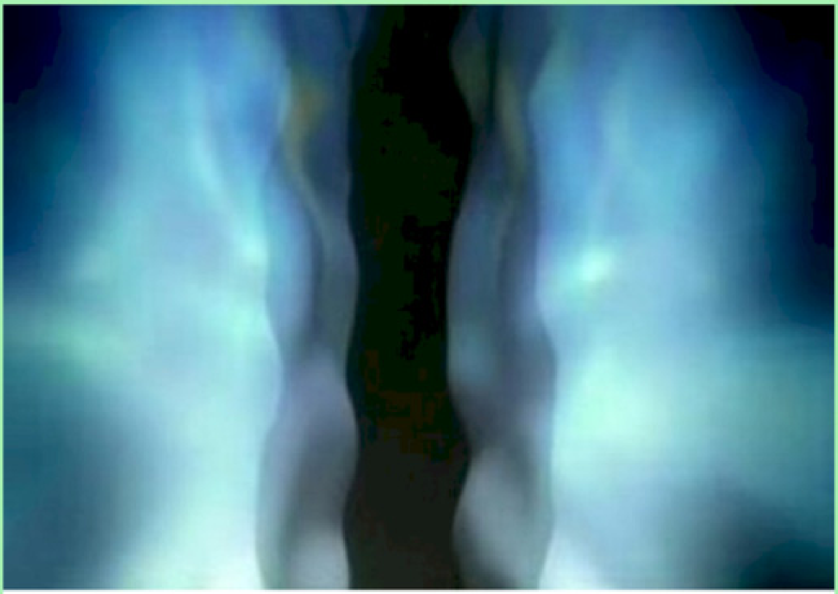
The speculation on incorporating additional dimensions into space-time goes back to the ideas of the Polish physicist Theodor Kaluza in 1919 and, independently, the Swedish physicist Oscar Klein in 1926. They asked why it was not possible that electromagnetism could be unified with gravity in a notional five-dimensional universe, or that perhaps the electromagnetic force may relate to some curvature in a fifth dimension, just as gravity is due to curvature in four-dimensional space-time, as demonstrated by Einstein's General Theory of Relativity. In fact, string theory started out as a theory in an unbelievable 26 dimensions, and was reduced to the 10 dimensional theory known as superstring theory (shorthand for "supersymmetric string theory") after the discovery of a symmetrical mathematical object called a "Calabi-Yao shape".

General Relativity, which implicitly interprets gravity as curvature in four-dimensional space-time, is built in to the basic precepts of superstring theory in a way that may be consistent with quantum mechanics, and so it is hoped that the long-sought synthesis between gravity and quantum theory will naturally emerge. In fact, over ten dimensions (in which all but the four we are familiar with are "curled up" into tiny strings with diameters on the order of the Planck scale), it may even be possible that all the fundamental forces in nature can be accommodated into one "theory of everything", known as quantum gravity.

Superstring theory may also go some way towards explaining another problem, which has dogged physicists for years: why gravity is so very weak compared to the other fundamental forces. If strings, which are too small for us to see or measure, incorporate other dimensions, then it has been posited that perhaps the effects of gravity can only be felt in their entirety at the level of higher dimensions, which we cannot perceive. However, the very fact that strings are too small for us to see (and probably too small for us to EVER see) have led some to question whether string theory is science at all, or whether it falls into the realm of philosophy.

The validation of superstring theory, though, is all in the mathematics, and it remains frustratingly abstract and theoretical, particularly as we are clearly not able to actually observe such tiny objects, nor to clearly visualize the multi-dimensional aspects. Moreover, at least five different and competing superstring theories have developed, none of which are conclusive, however elegant. Since Ed Whitten's contribution to the field in 1995, though, there is some evidence that the inclusion of an eleventh dimension might be able to reconcile these competing theories, to show them as being just five different way of looking at the same thing. It might also make superstring theory consistent with supergravity theory (which had been largely disregarded since the early 1980s).

With the additional eleventh dimension, the fundamental building block of the universe was therefore no longer a string but a “membrane” or “brane”, leading to the theory's designation as “membrane theory” or “M-Theory”, first described by M-Theory pioneer Bert Ovrut in 2001. It soon became clear, though, that the new eleventh dimension was, if anything, even stranger than the other special dimensions of superstring theory, being infinitely long but only 10^{-23} metres wide, so that it theoretically exists at less than a trillionth of a millimetre from every point in our three-dimensional world but is totally insensible to us.



Artists visualization of rippling membranes

M-Theory and the incorporation of an eleventh dimension is also consistent with the existence of a multiverse, a convenient but ultimately improvable solution to many of the more intransigent problems in theoretical physics. For example, if the membranes move and ripple, as it is supposed they do, then events like singularities (and the Big Bang itself) can be visualized as the result of chance collisions between rippling, wave-like membranes, with the initial Big Bang of our universe being just one of many in the constant encounters between membranes in parallel universes.

This vision of the eleventh dimension suggests a much more violent and active place than the early visualizations of membranes serenely floating in space. It also suggests that time can in fact be followed back though the initial singularity of the Big Bang of the universe we know to the parallel universes, which gave rise to it (in what is sometimes described as the "Big Splat"), a possible solution to an intractable problem which has dogged physicists since the Big Bang theory was first mooted. This all conjures up the rather unsettling idea of an infinite number of universes, potentially each with different laws of physics, of which ours is just a single insignificant member, part of an endless multiverse, where Big Bangs are taking place all the time.

But the existence of parallel universes seems to provide plausible solutions to most of the outstanding problems with the theory. For example, some physicists (notably Lisa Randall) believe that M-theory may explain the apparent weakness of the force of gravity in our universe, if the strings that we experience as gravity (known as gravitons) are not open-ended strings which are tied down to our three-dimensional membrane or universe (as are the strings of particles and other forces), but self-contained closed loops of string which are therefore free to escape into other dimensions we are not able to experience. Or, alternatively, if we are only experiencing small leaks of the full force from other nearby membranes (and other universes).

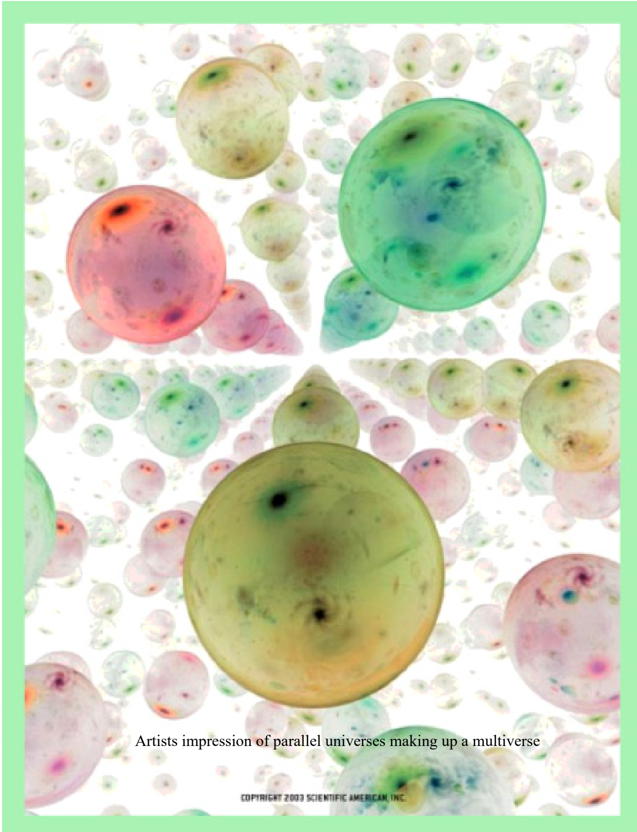
Superstring theory (and its off-shoot, M-Theory), though, is by no means the only candidate for a "theory of everything" which is being pursued. Indeed, some physicists think that it has been a disaster for science, taking many of the best brains off on a wild goose chase. Other approaches include "loop quantum gravity" (in which space is represented by a network structure called a "spin network", and particles are woven and braided together out of Planck lengths of space, evolving over time in discrete steps), "causal dynamical triangulation" (a background independent approach which attempts to show how the space-time fabric itself evolves), "causal sets" (an approach which assumes that space-time is fundamentally discrete and that space-time events are related by a partial order) and even a recent one called "An Exceptionally Simple Theory of Everything".

Conclusion

The theory of the Big Bang, as modified by the inclusion of dark matter, cosmic inflation and dark energy, is still the best explanation we have for the origin of the universe. However, there are still gaps and inconsistencies in our knowledge, and perhaps the nagging suspicion that the more we learn and the more questions we answer, the more there is to learn and the more new questions arise.

Since the 1980s, steps have been taken towards a "quantum theory of gravity", such as the theory of super strings mentioned in the previous section, steps which many physicist believe are necessary before we can advance any further in our understanding of the universe. However, the mathematics involved is hugely complicated, the tiny scale is inherently unobservable, and it is difficult to tell just how much progress is actually being made, and how much of the enthusiasm being shown is merely due to the elegance and the compelling apparent "rightness" of the theory.

It is apparent, though, that the laws of physics and the fundamental forces that have led to the creation of the universe as we know it (with all the complexity of stars and galaxies, a complex and interactive periodic table of elements, intelligent life, etc), are extremely sensitive to any change. For example, even a relatively slight difference in the ratio of the strength of the strong force holding atoms together to the force of gravity(about 10^{38}) would result in a much shorter or longer life for stars and much less favourable conditions for complex evolution, quickly leading to a featureless, sterile universe. If the very small mass difference between neutrons and protons (about one part in a thousand) were changed by only a factor of two, then the abundance of elements in the universe would be radically different from that observed today.



Artists impression of parallel universes making up a multiverse

For some, the extent of these apparent coincidences and "fine tuning" have led them to attribute it to the hand of God and so-called “intelligent design”. Others have invoked the “anthropic principle” that this universe appears to be fine-tuned for life, specifically human life, and therefore could not be any other way (if it were, then would not be here to observe it).

As for the oft-posed question of what was there before the Big Bang - why there is Something rather than Nothing - physics as it stands has no answer, and such a question is considered effectively meaningless by most physicists. If matter, space and time all came into being with the singularity we call the Big Bang, then so did the concerns of physics, they argue, and any discussion of what came before is therefore an exercise in metaphysics and philosophy, not physics. If pressed, most scientists would probably have to answer: “As far as we know, nothing”.

New work on eleven dimensional superstring theory and M-theory, though, is suggesting plausible answers to even this audacious question. Among other ideas, it is hypothesized that the universe that we inhabit is just one of a potentially infinite number of parallel universes (the "multiverse"), some of which may have the same physical laws and fundamental forces but fine-tuned slightly differently, and some of which may have an entirely different set of laws and forces. What we think of as the Big Bang was just one of many collisions between rippling membranes in the eleventh dimension, and merely the result of two parallel universes momentarily coming together.

Others, like the Ukraine-born American physicist Alexander Vilenkin, claim that such extravagant theories are not needed to explain how Something came out of Nothing, and that quantum theory, and more specifically the concept of quantum tunnelling and the virtual particles that pop into existence apparently out of nothing as a result of the uncertainty principle (see the sections on Quantum Theory and the Uncertainty Principle for more details), are quite sufficient to explain how the universe first came into being.

Σ Π

A Clear and Certain Path Replacing the Lambda Cold Dark Matter model: With a more observationally Verifiable, and much less-problematic Cosmology

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Abstract: At the greatest distances, the observations made by the James Webb Space Telescope (JWST), and those it is likely to continue to make based on our research, are believed by many to contradict mainstream cosmology's predictions about the most distant universe. One of the defining differences between the Big Bang (BB) model and prior steady state (SS) models was that SS models proposed the observable universe remained unchanged in its general appearance. Interestingly, many now believe that the JWST is observing such an unchanging appearance.

In the 1960s, observations seemed to contradict a steady-state universe because quasars and radio galaxies were only observed at great distances, with none close by, and mainstream theory suggested that galaxies first began forming roughly 11.6 billion years ago. However, over time, some of the perceived advantages of Big Bang cosmology have become questionable based on more recent observations. Predictions made before the JWST's launch appear to be continuously contradicted by its observations.

Some believe that what we are observing with the JWST at the greatest distances appears very similar to the Hubble Deep Field photos and also to images of local galaxy clusters, suggesting a generally unchanging condition of the observable universe. This research study aims to elucidate the numerous ongoing issues with Big Bang cosmology, whose once-clear advantages have become less apparent. Conversely, the alternative cosmology we present has not encountered contradictions or required ad hoc hypotheses over many decades.

Our study will provide a comprehensive analysis of these observations, detailing the dozens of continuing problems with Big Bang cosmology. We will also discuss how the claimed advantages of the Big Bang model are no longer as clear-cut in light of new evidence. On the other hand, the alternative cosmology we propose has consistently aligned with observational data without necessitating additional hypotheses.

Readers are invited to consider whether the latest observations made by the JWST contradict Big Bang cosmology, and to evaluate whether the alternative cosmology we offer presents fewer problems. We will explore whether the many predictions of each cosmology are being confirmed or contradicted by the JWST and other observations of the distant universe. Ultimately, this study seeks to provide a clearer understanding of the universe's nature, offering evidence that may challenge or support existing cosmological models.

In conclusion, the observations by the JWST have opened new avenues for questioning established cosmological theories. As we continue to gather data, it is essential to re-evaluate our models and consider alternative explanations that may better fit the observed universe. This research aims to contribute to that ongoing dialogue, providing insights and evidence to help shape our understanding of the cosmos.

1. Introduction and preview of contents

The primary objective of this paper is to consider the well-know acknowledged (probable or possible) problems with the Lambda Cold Dark Matter (ΛCDM) version of the Big Bang model (BB), and to show what we believe to be the correct path to solve these problems via an alternative cosmology. An alternative cosmology is then presented that by its analysis, provides possible, and hopefully correct solutions to these well-known problems, as readers will consider. The use of the plural pronouns "we" and "our" in these writings relate to the author and one or more persons of the Pan Theory Research Organization that agree with the statements being made.

Note: We will discuss steady state cosmologies, but most search-engine references only refer to Fred Hoyle's Steady State model, the most well-known of these models. This model includes both the expansion of the universe and the creation of new matter. Prior steady state models before then, and some since, did not include either, and if neither they are often referred to as static-universe models. But for the purposes of this paper, we use the words "steady-state" to describe any cosmology that proposes that the observable universe is not evolving as a whole.

Sometimes links are also given in the text when the additional information might further clarify by providing longer explanations. What we predict will be "The Clear and certain path" is that the Lambda Cold Dark Matter model will have to be changed or replaced sooner rather than later because of present and future contradicting observations at the greatest observable distances, primarily by the James Webb Space Telescope (JWST).

Following the mainstream-problem section to follow is the alternative cosmology section, called the Pan Theory of Cosmology (PTC). This section includes a nine-page summary, and its supporting links involve hundreds of pages of research, study, and theory. Following this there is a short section regarding our predictions of what to expect from the JWST most-distant observations, and another section that is generally related but outside the purview of cosmology.

This short section is followed by our conclusions in regard to those interested in a replacement cosmology, with suggestions on how to proceed in analyzing such as cosmology regarding the BB problems presented, and in consideration of the present and predicted future observation anomalies expected concerning mainstream cosmology.

2. The Many Problems of mainstream Cosmology

Mainstream Cosmology today proposes comprehensive explanations for a broad range of observed phenomena, including the abundance of light elements, the asserted evolution of the universe over time, and the asserted source of the cosmic microwave background radiation (CMBR), claimed to have been accurately predicted before its discovery. But the theory also has recognized problems; some of the most well known of these will be discussed here.

The overall many-times-verified uniformity of the universe, which also relates to the flatness problem of the BB model, is believed to have been explained by the many cosmic Inflation proposals, i.e. a sudden and very rapid expansion of space and energy plasma during the earliest moments of the universe. By the same means the so-called Horizon problem (discussed below) was also thought to have been resolved. However BB cosmology no longer proposes an explanation for the very beginning of the universe, which was originally considered a singularity. Newer observations have also brought further theory detail into question, which will be discussed.

*2.1 The Lambda Cold Dark Matter theory and its more recognized problem*s

The link below discusses what many believe to be Big Bang (BB) problems of theory, some or most of which are recognized as problems by mainstream theorists. Nearly all of these problems do not exist with the alternative cosmology being presented. Many of these problems will also be discussed in further detail in the subsequent Pan Theory of Cosmology section of this paper. [6])

https://en.wikipedia.org/wiki/List_of_unsolved_problems_in_physics

(the cosmology and general relativity section)

"The following is a list of notable unsolved problems grouped into broad areas of physics.

Some of the major unsolved problems in physics are theoretical, meaning that existing theories seem incapable of explaining a certain observed phenomenon or experimental result. The others are experimental, meaning that there is a difficulty in creating an experiment to test a proposed theory or investigate a phenomenon in greater detail.

There are still some questions beyond the Standard Model of physics, such as the strong CP problem, neutrino mass, matter–antimatter asymmetry, and the nature of dark matter and dark energy.[2][3] Another problem lies within the mathematical framework of the Standard Model itself—the Standard Model is inconsistent with that of general relativity, to the point that one or both theories break down under certain conditions (for example within known space-time singularities like the Big Bang and the centers of black holes beyond the event horizon)Some of these answers are based upon our extensive research, and some are additionally supported by new observations by astronomers. Many readers will already know some mainstream explanations and answers for these problems. By reading the above link (…unsolved problems of physics), readers can see our source for most of the problems to be discussed below.

Following these asserted problems and alternative explanations, the proposed alternative cosmology is presented and explained in some detail. By this, readers can judge for themselves whether this alternative cosmology would eliminate many or maybe all of these discussed problems."

2.2 List of the better-known problems of mainstream cosmology (accessed 10.06.2023)

Explanations, answers, and statements in the text are in accord with the alternative cosmology, the Pan Theory of Cosmology (PTC). The answers presented, if valid, could explain away most of these asserted problems. But of course they are not the only reasonable answers and explanations to these problems. Some mainstream theorists and alternative-mainstream theorists have their own answers and explanations, as well as those of other alternative theories – and some would even say that few of these are real BB problems.

- Dark matter: What is dark matter? Dark Matter is a hypothetical entity, a kind of placeholder for an unknown force. Most believe that it is a particle (vast volumes of particles of an unknown type of non-baryonic matter) that has never been directly identified. What is it?

Answer APT: Non-baryonic Dark Matter has never been directly observed because it probably doesn't exist. Instead, the additional force influence within spiral galaxies and galaxy clusters that increase stellar velocities is instead a flowing vortex pushing force of the background field, the Zero Point Field (ZPF), a presently unrecognized force.

The proposal and equations explained in the links below result in "calculations that exactly match observations."

https://scholar.google.com/citations?view_op=view_citation&hl=en&user=7ONCj-kAAAAJ&citation_for_view=7ONCj-kAAAAJ:2osOgNQ5qMEC

> *"The model we are proposing, based upon our research, makes exact predictions of spiral galaxy velocity profiles (stellar velocities) solely based upon a galaxy's observed galactic matter, totally contrary to the dark matter hypothesis. Making exact predictions for all symmetric spiral galaxies is something that no other model can do, based upon our research. Based on our preconceived hypothesis, the goal of our research was to correctly explain the reasons for observed spiral galaxy velocity profiles and to propose new equations, if needed, for such calculations. In contrast, our research has shown that dark matter proposals usually make very poor predictors of stellar velocities within spiral galaxies and elsewhere based upon assumptions of normal matter distribution.*
>
> *Another goal of our research was to explain increased velocities observed in galaxy clusters, and velocity anomalies within the observable universe, based on the same proposed mechanism. We also explain that modified-gravity models have their own problems relating to predictions of galaxy-cluster velocities and must also propose unseen, but known matter for these calculations. The alternative model being presented proposes what can be called background Field-Flow dynamics. Its unique Newtonian-style equations, and their exact predictions concerning all spiral galaxies studied and presented, we believe are very convincing evidence in support of this model and proposal.*

https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3. (accessed 10.06.2023)"

> *In our recent report, observational evidence supports that the rotational direction of a galaxy tends to be coherent with the average motion of its nearby neighbors within 1 Mpc. We extend the investigation to neighbors at farther distances in order to examine if such dynamical coherence is found even in large scales. The Calar Alto Legacy Integral Field Area (CALIFA) survey data and the NASA-Sloan Atlas (NSA) catalog are used. From the composite map of velocity distribution of "neighbor" galaxies within 15 Mpc from the CALIFA galaxies, the composite radial profiles of the luminosity-weighted mean velocity of neighbors are derived.*
>
> *These profiles show unexpectedly strong evidence of the dynamical coherence between the rotation of the CALIFA galaxies and the average line-of-sight motion of their neighbors within several-megaparsec distances. Such a signal is particularly strong when the neighbors are limited to red ones: the luminosity-weighted mean velocity at $1 < D \leq 6$ Mpc is as large as 30.6 ± 10.9 km s^{-1} (2.8σ significance to random spin-axis uncertainty) for central rotation ($R \leq Re$). In the comparison of several subsamples, the dynamical coherence tends to be marginally stronger for the diffuse or kinematically well-aligned CALIFA galaxies. For this mysterious coherence in large scales, we cautiously suggest a scenario in which it results from a possible relationship between the long-term motion of a large-scale structure and the rotations of galaxies in it.* (Accessed 10.06.2023)"

- Dark energy: Dark Energy is the supposed source of the accelerating expansion of the universe, but what is its cause and nature? Answer PTC: Like dark matter, Dark Energy also doesn't exist, according to the peer-reviewed research paper, link below. Its believed existence is accordingly based upon the inaccuracy of the Hubble distance formula, which is assertedly wrong by at least 10% when calculating redshift distances at z ~ .6 by the alternative cosmology's equations– as explained in the link below.

https://pdfs.semanticscholar.org/18af/86eb09dbf86df826906392e2eb4c9f876d8d.pdf

> *The purpose of this research and study was to help derive and test new theoretical equations to accurately determine cosmological distances and luminosities for all cosmological entities without the need for the dark energy hypothesis. These derived equations were based upon an alternative cosmological model and a study of type 1a supernovae observation data. This paper presents the results of this research and study and the resultant new equations. A new distance equation is presented in this paper for peer consideration for the first time. It is proposed as an eventual replacement for the Hubble distance formula concerning calculated cosmic distances based upon redshifts.*
>
> *A new "brightness equation" is also offered herein. Its calculations are required to accompany the calculations of the distance equation to determine brightnesses and are proposed as an addendum to the inverse square law of light concerning luminosity calculations for cosmic-redshifted distances. In the subject supernova study these alternative equations are used to show their application and proposed validity concerning calculated distances and observed brightnesses of type 1a supernovae. The proposed alternative distance equation is very different from the Hubble distance formula since it is directly linear and was derived from an entirely different non-expanding-universe cosmology, tested and refined based upon a study of type 1a supernova data involving the subject applied physics research.*
>
> *Explanations of the alternative cosmological model are presented here for the consideration of their merits. Hopefully these proposed equations will be tested by many others concerning all types of cosmological-distance observations of redshifts requiring distance and brightness-determination calculations, eventually resulting in the serious consideration of the subject cosmological model for reasons discussed in this paper.* (Accessed 10.06.2023)"

- The Hubble Constant Controversy:_In 2020 the so-called Hubble Constant Problem began to surface as another BB problem. Two different methods to measure its quantity have yielded results about 10% different from each other, but neither value falls within the error range predicted by the other method. The primary method of calculation is based upon direct measurements and related calculations, up to a redshift of about z = 1, where distances might also be tested by other methods of distance determination other than redshifts, part of the so-called distance ladder. This was the only method used to determine the Hubble constant of the BB model in the past, direct observational measurement. But a second method was developed in the 1990's to determine the Hubble Constant. This method involves assumptions and interpretations of the cosmic microwave background radiation based upon BB theory. Some have called this BB problem a **cosmological crisis,** which continues as an unexplained problem of BB cosmology today.

Explanation APT: The alternative model states that direct measurement is always better than measurement based upon theory, so the microwave background radiation calculation is less reliable since it is based upon both theory and measurement. The distance equation of the alternative model, as seen in the link above, requires no Hubble constant for its distance calculations. The bottom line of the problem, however, is two-fold. APT: The Hubble distance formula is wrong, and the understanding of the microwave background radiation is also wrong, as explained below in the PTC section.

- The Fine Tuning Problem: The characteristics of the universe seem to be finely tuned suggesting that if any of the so-called free constants of nature, also called free parameters, were just a little bit different, the universe could then be totally different — and that life as we know it probably would not exist.

Answer APT: The so-called constants of nature, described as free parameters, are not free. Instead they are inter-related to each other and with other parameters in presently unknown ways. If true, the universe can only exist in one form and condition, the condition we observe. This assertion is totally contrary to the Many Worlds interpretation of Quantum Mechanics as a more-extreme example. Further explanations can be seen in the link and section given below:

https://www.researchgate.net/publication/353588675_Theory_of_Everything

> “What is a Theory Of Everything (TOE)? The present understanding of such a theory is one that can combine the worlds of the big and small together without contradiction. Such a theory supposedly should be able to combine Quantum Mechanics (QM) and General Relativity theory(GR) with congruency, and at the same time provide a better insight into both theories and into reality. TOE’s in general contain the hypothetical framework designed for that purpose. A prior attempt and example at forming a Theory of Everything was the well-known mathematical-based (theoretical physics) proposal called String Theory.
>
> We believe a major problem with this type of mathematical proposal was that one must generally assume that both Quantum Mechanics and Generally Relativity are generally correct theories without errors, to begin with. Secondly a new theory should be able to make new observable predictions, but String Theory could make none. We make the opposite assertion in our quest for a Theory of Everything. We instead assert based upon the evidence presented, that both QM and GR have mistakes within them which make them wrong – at least to some major extent. For this reason we consider our approach to be an ”outside –the-box” approach. But to make such a proposal it will be necessary to show what’s logically wrong with each theory. Once these asserted errors of logic and theory are supposedly corrected for each theory, these theories accordingly would be compatible without contradiction, according to this proposal. Even if our proposed changes-of-theory were all correct, most believe there also should be an

advantage for joining the theories together. Again our approach is different. Although we will propose new mathematics, the TOE being presented is primarily based upon logic. The new mathematics presented is to enable better quantitative predictions, but also to provide a better understanding of reality. Also, we propose that each theory is very different from the other; and that to combine them physically would be of no benefit. The advantage of this theory, other than better predictions and understandings, is simply to show that the quantum realm, when compared to the atomic, molecular, and galactic realm, do not contradict each other in any way, according to the conclusions of this proposal. Although Quantum Mechanics is the best statistical and mathematical system available for making predictions in the quantum realm, there is no consensus theory or version, which logically explains quantum behavior. This is the all-important missing characteristic of QM; simply that logic is missing. This is the primary obstacle to a theory of everything according to this proposal. General Relativity theory also has its own limitations as explained below.

This Theory of Everything (TOE) proposes a new, mush simpler combined theory of the worlds of the big and small, controlled by local hidden variables of the Zero Point Field, which accordingly dominates both the quantum realm and the world at galactic scales. This is the missing ingredient of which neither realm has an adequate understanding. As for the equations of General Relativity (GR), they are only good to about 5 kilo-parsecs (about 16 light years) as will be shown. Beyond that distance GR fails concerning its predictive power. It is presently believed that these failings are due to the presence of dark matter, and that if dark matter was included, gravity equations would be correct. But our prior research has shown that this belief is not valid. Instead the dark matter hypothesis is simply wrong (references below). Even if dark matter didn't exist, that still wouldn't necessarily make GR wrong, but it seemingly would not be possible to prove the validity of GR at cosmic distances without a similar hypothesis to dark matter. Our prior research and related evidence not only explains away dark matter, but also claims that many other wrong hypotheses exist in present-day cosmology. But for the purpose of this proposal, at least dark matter must be discarded based upon the evidence that will be presented, so that this Theory of Everything can come together." (Accessed 10.06.2023)

- Origin of the universe: How did the conditions arise that resulted in the creation and formation of the universe in the first place?

Answer APT: This question is simply based upon false assumptions. The primary false assumption is that there were conditions that preceded the universe to cause its creation to start with, which according to the alternative theory below, there were not. The second false assumption is simply that the universe could exist in a form different from how we presently observe it, which is not possible according to the alternative theory.

Does the Universe evolve and if so how, and what is its future? Is the universe headed towards a Big Freeze, a Big Rip, a Big Crunch, a Big Bounce? Is it part of multiverse? — An infinitely recurring cyclic model, etc.?

Answer: The evolution of the universe is a very important difference of theory for mainstream cosmology. It was one of the three so-called advantages of the Big Bang model over a steady state universe, along with the Big Bang creation of the observed abundance of light elements, and that the observed microwave background radiation, which was explained by a Big Bang event, and was predicted before it was discovered.

According to the alternative cosmology, the observable universe is not evolving. It is in a steady-state condition with only local evolution cycles of stars, galaxies, and galaxy clusters, etc. The observable universe, as well as the universe as a whole, accordingly would be vastly older and larger than what present theory and the Hubble distance formula could allow.

- Cosmic Inflation: Is the theory of cosmic inflation in the very early universe correct?

Answer APT: The simple answer is no. Cosmic Inflation never occurred, nor is the universe or space expanding. Instead matter is very slowly getting smaller: about 1,000th part every 7 million years. This is the cause of the observed galactic redshifts. The evidence for this is observed as fermion particle spin, which is real. Fermion-spin is now called angular momentum because they have no explanation concerning the source of energy for real particle spin, but the Pan Theory below does.

- Horizon and Flatness problems: Why is the distant universe so homogeneous when the Big Bang theory seems to predict larger measurable anisotropies of the night sky than those observed?

Answer: In the 1980's the primary acknowledged BB problems were the **Horizon** and **Flatness problems, which** eventually resulted in a number of Inflation proposals, which many believe solved these problems. Because an Inflation era could never be observed or tested, and because there was no basis for it in classical physics, the use of Inflation theory to solve problems in cosmology was questionable based upon the scientific method. Some have called it Inflation metaphysics, to disparage and discourage the use of unobservable and untestable propositions in scientific theory, excepting for maybe speculative considerations prior to theory formation or changes.

- Size of the universe: The diameter of the observable universe, according to BB theory, is about 93 billion light-years, but what is the size of the whole universe?

Answer APT: The simple answer is that the Big Bang model of the universe is wrong. Instead the observable universe is in more of a steady-state condition, not infinite is size, but vastly larger and older than what is presently believed based upon mainstream theory.

- Baryon asymmetry: Why is there far more matter than antimatter in the observable universe? Could this be due to the asymmetry of longevity between matter and antimatter?

Answer APT: Yes, this is the correct answer. Antimatter has a half-life that can be counted in millions of years or less, rather than countless billions of years like protons. The alternative theory below explains why their half-lives are different.

- Cosmological principle: Is the universe homogeneous and isotropic at the largest scales, as assumed by all models that use the Friedmann–Lemaître–Robertson–Walker metric, including the current version of the ΛCDM model?

Answer: Yes, the universe is generally isotropic but its homogeneity is not consistent with the mainstream metric of the ΛCDM model. The Friedmann—Lemaître–Robertson–Walker metric simply doesn't apply since this metric is based upon Einstein's gravity equations, and not based upon expanding space, which is the present mainstream explanation for an expanding universe. And according to the alternative cosmology, neither the observable universe nor space is expanding, as will be explained.

- Copernican principle: Are cosmological observations made from Earth representative of observations from the average position in the universe?

Answer APT: Generally speaking, yes.

- Cosmological constant problem: Why does the zero-point energy (ZPE and ZPF) of the vacuum not cause a large cosmological constant? What cancels it out?

Answer APT: The outward pushing forces of the Zero Point Field (ZPF) are the same as its inward pushing forces, which we call gravity. So the inward pushing forces of gravity generally cancel out any outward pushing forces; they are one in the same. The actual pushing forces of the Zero Point Field are a part of the gravitational constant 'G,' which is **6.67×10^{-11} Newtons/ m^2** – a superfluid-like omnipresent aether atmosphere of sorts, which is the source cause of gravity.

- The Dark flow: Are the galactic motions of this flow due to the gravitational pull from outside the observable universe responsible for some of the observed motion of large objects such as galactic clusters in the universe?

Answer: The Dark Flow has an unknown cause but is a common type of field flow caused by the pushing forces of the Zero Point Field, which can be seen in spiral galaxies, galaxy clusters, and all over the universe, but is presently unrecognized. Its influences are often attributed to gravity and dark matter. A number of observation examples of this field flow, other than in spiral galaxies and the dark flow, can be surmised from reading the link below:

https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3

> In our recent report, observational evidence supports that the rotational direction of a galaxy tends to be coherent with the average motion of its nearby neighbors within 1 Mpc. We extend the investigation to neighbors at farther distances in order to examine if such dynamical coherence is found even in large scales. The Calar Alto Legacy Integral Field Area (CALIFA) survey data and the NASA-Sloan Atlas (NSA) catalog are used. From the composite map of velocity distribution of "neighbor" galaxies within 15 Mpc from the CALIFA galaxies, the composite radial profiles of the luminosity-weighted mean velocity of neighbors are derived. These profiles show unexpectedly strong evidence of the dynamical coherence between the rotation of the CALIFA galaxies and the average line-of-sight motion of their neighbors within several-megaparsec distances. Such a signal is particularly strong when the neighbors are limited to

> red ones: the luminosity-weighted mean velocity at $1 < D \leq 6$ Mpc is as large as 30.6 ± 10.9 km s^{-1} (2.8σ significance to random spin-axis uncertainty) for central rotation ($R \leq Re$). In the comparison of several subsamples, the dynamical coherence tends to be marginally stronger for the diffuse or kinematically well-aligned CALIFA galaxies. For this mysterious coherence in large scales, we cautiously suggest a scenario in which it results from a possible relationship between the long-term motion of a large-scale structure and the rotations of galaxies in it.
> (Accessed 10.06.2023)

- Shape of the universe: What is the "shape" of the universe? Neither the curvature nor the topology of the universe is presently known for certain, although its curvature is known to be zero or close to it at observable scales.

Answer APT: The universe appears to be flat, meaning that there would be no fourth physical dimension or warped-space to it. Instead the background Zero-Point-Field has density variations and field flows within it that are presently explained by the supposed warping of space-time. The universe is generally spherical in form with three-dimensional boundaries. Space is simply the distance between matter and the volume that matter and field occupy and nothing more. Space does not exist beyond the boundaries of matter and the ZPF by this definition.

- Are the Largest Structures of the universe contrary to mainstream cosmology? The Sloan Great Wall is 1.38 billion light-years in length. And the largest structure currently known, the Hercules–Corona Borealis Great Wall, is up to 10 billion light-years across. Are these actual structures, or just random density characteristics?

Answer APT: Yes, these structures are real and are forms within the observable universe, a somewhat fractal kind of universe. The observable universe might be considered “just like a drop in the bucket,” compared to whole universe, yet it is still finite in every way. Also in a steady state universe there would be a great deal more time available for such gargantuan structures to form.

- The Cosmic Density Problem:_ Why has there never been an acknowledged and journal-published study concerning the verification of the expansion of the universe? Cosmic density studies can be made with the technology of today’s astronomy.

Answer APT: This BB problem has rarely been addressed by either astronomers or theorists since the theory began and remains a primary, if not the biggest BB problem since it relates to the theory's foundation premise, that the universe is expanding and therefore was denser in the past. But the problem is that this premise has never been verified by any acknowledged or widely published large-scale density study. To the contrary, some observation studies have suggested that the universe was even less dense in the past. Others have used hypothetical dark matter along with observations, trying to prove a higher matter density in the past – the results were unconvincing to most.

A denser universe in the past is a prime requisite of BB cosmology regarding an expanding universe without the creation of new matter, which distinguished it from Hoyle's Steady State theory, the proposed continuous expansion of space since the end of the hypothetical Inflation era.

- The Too Thin Universe Problem: This problem is directly related to the Cosmic Density Problem explained above. The universe appears to have been too thin for galaxies and the observed large-scale structures to have formed in the first place based upon gravity alone, within the limited time allowed by the Hubble distance formula, 13.8 billion years. What is the answer to this problem?

Answer APT: This is an older but more recognized problem that the universe of the past and present, based upon extensive observation studies, appears to be too thin to have created the observed quantities of galaxies and galaxy clusters in the first place based upon the expansion of the universe from the observable past. Many believe that not even a denser past universe of the Big Bang theory was even dense enough to have formed the plentitude of observable galaxies, or the known structures of the observable universe based solely upon gravity, within the Hubble restricted age of the universe, even with the inclusion of hypothetical dark matter. Some consider this one of the biggest BB problems. It is also called the **"Cosmic Tension."**

https://www.quantamagazine.org/a-new-cosmic-tension-the-universe-might-be-too-thin-20200908/

> The cosmos is starting to look a bit weird. For a few years now, cosmologists have been troubled by a discrepancy in how fast the universe is expanding. They know how fast it should be going, based on ancient light from the early universe, but apparently the modern universe has picked up too much speed — a clue that scientists might have overlooked one of the universe's fundamental ingredients, or some aspect of how those ingredients stir together.
>
> Now a second crack in the so-called standard model of cosmology may be forming. In late July, scientists announced that the modern universe also looks unexpectedly thin. Galaxies and gas and other matter haven't clumped together quite as much as they should have. A few earlier studies offered similar hints, but this new analysis of seven years of data represents the cleanest stand-alone indication of the anomaly yet. "If we were having conferences," said Michael Hudson, a cosmologist at the University of Waterloo in Canada who is not involved in the research, "all the coffee chatter would be about these results."
>
> Like most measurements of the large-scale structure of the present-day universe, the study is fraught with technical difficulties. It's also possible, though unlikely, that the results are due to chance. Nevertheless, some researchers wonder if the trend toward increasingly funky measurements may foreshadow the discovery of a new cosmic agent. "We've already got dark matter and dark energy," Hudson said. "I hope we don't need another dark thing."
> (Accessed 10.06.2023)

- The Predicted abundance of light elements — the mathematics of this hypothesis was originally formulated for predictive purposes based upon a singular Big Bang event, which is no longer part of the BB theory. Although a number of its predictions are close to being correct even today, other aspects of it are less accurate and more problematic. Can this hypothesis still be justifiably used based upon the different creation-of-matter events proposed by the ΛCDM model? – if so, can these predictions be justifiably improved?

Answer APT: The original theoretical physics concerning the creation of light elements was ad hoc, based upon theory with the abundance of the light elements quantities generally known at the time of its "predictions." This ad hoc characteristic of the theory was also a criticism of it by Hoyle and other steady state proponents at the time of its creation. It was an advantage over Hoyle's steady state model because nuclear fusion theory cannot explain why these observed abundances exist.

The alternative Pan Theory of Cosmology, below, also explains as part of its theory, that nuclear fission and fusion events at the bases of galactic jets also explain the abundance of light elements. If more ad hoc theory is needed to quantify these abundances for any theory, better proposals can now be contrived because more accurate percentages of these abundances are now known.

- The Axis of evil: Some large features of the microwave background radiation (MRB) coming from events believed to have happened over 13 billion years ago appear to be aligned with both the motion and orientation of our solar system. Is this due to systematic errors in processing, contamination of the results by local effects, or an unexplained violation of the Copernican principle?

Answer APT: Contrary to the Big Bang model, the MBR is not cosmic in origin and instead relates to local temperatures within our galaxy. When looking at the night sky, more often in the southern hemisphere, the night sky appears brighter in the direction of the observable arm of the Milky Way, part of the plane of our galaxy. A brighter sky in outer space has a slightly higher temperature to it, a small but significant difference. All matter radiates EM radiation, but for the intra and extragalactic fine-grained matter of space, this radiation is in the microwave spectra (very faint, low temperature radiation), which according to this proposal is the source of the observed MBR. It is the local temperature of our part of the galaxy. For instance, the Milky Way core temperature of interstellar fine-grained dust and atomic matter, the MBR temperatures there should accordingly be at least several times higher than in our part of the galaxy because of its far greater stellar density. Temperatures everywhere within a galaxy are made more uniform by continuous absorption and radiation of excess temperatures by fine-grained matter and presently unknown conduction processes with the Zero Point Field.

As to an older-universe cosmology like the PTC, there would be much more time available for the MBR temperatures to caramelize. [9]

2.3 Prelude to the Pan Theory of Cosmology directly below

Comments, Axis of Evil APT: Mainstream theorists have asserted that Eddington's [10] estimates of the temperature of outer space, 3.1K degrees, was just a lucky guess based upon his hypotheses and calculations. Outer space in his time only involved the temperature of the Milky Way since it was the only known galaxy. If only a lucky guess, then what is the real temperature of outer space in our galaxy is as measured today (the space between the stars containing mostly hydrogen)? Is it measured in a different way? Is it observed at different EM frequencies than the microwave background? A search for the answer to this question only gives a temperature of 2.7 degrees K. But this is the temperature of the microwave background radiation, the supposed CMBR. Doesn't any part of this temperature include the temperature of outer space and the stars and galaxies within it as they shine down on the outer space of our galaxy? Is the temperature of the outer space in our galaxy simply zero?

If any part of this observed 2.7K MBR temperatures is the temperature of outer space in our galaxy wouldn't that explain the so-called Axis of Evil? So if the temperature of space heated by all the stars and galaxies is not simply zero, then shouldn't it be a part of the CMB temperature also? These were the questions being asked by SS theorists to BB theorists during the mid to late 1960's. Maybe the most common reply was another question. But what about the extreme uniformity of this temperature, how is that explained?

Another statement by SS theorists at that time was that if any part of the MRB radiation is the temperature of outer space in our galaxy, then Occam's razor would suggest that it's the only part of the microwave background radiated temperature since that is the simplest explanation, one heat source instead of two.

https://academic.oup.com/astrogeo/article/45/3/3.10/237014

> In the late 19th century, Kelvin and Helmholtz had suggested gravitational energy release during contraction as the source of the observed stellar luminosity; but this yielded a time-scale far less than geological estimates for the age of the Earth. In 1920 Eddington pointed to the mass difference between four H atoms and one He atom as the likely energy source. However, his theory of stellar structure aimed rather to calculate the luminosity L of a main-sequence star of given mass M and composition from the basic physics of radiative transfer. By use of a draconian approximation, he produced his "standard model" for a homogeneous star, with radiation pressure PR comparable with gas pressure PG, but with the energy liberation per gram nearly uniform. The model yielded his celebrated "Mass—Luminosity Relation", with L increasing strongly with M. Applied to the observed main sequence, with the radius R of each star determined from L and the surface temperature Te, it is found that the central temperature Tc increases slowly with increasing M, implying a rate of supply of subatomic energy that is very sensitive to temperature. This prediction was confirmed in the late 1930s by calculations of thermonuclear H→He processing, but is inconsistent with the approximation that yielded the

standard model. Subsequent work showed that Eddington's M—L relation is really an M—L—R relation in disguise, but with only a weak R-dependence. Under the Kramers opacity law, radiative transfer alone does effectively fix L, and the strongly T-dependent energy generation fixes R. But, contrary to Eddington's expectation, for the observationally inferred opacity to agree with the physical, the stars must have a large H and He content; and also PR PG except in the most massive stars. Nevertheless, Eddington's pioneering work set the scene for nearly all subsequent research on stellar structure and evolution.

Biermann and Cowling showed that main-sequence stars will have convective zones, but the M—L relation remains robust for most of the mass-range. For M less than M /4, the star is fully convective, as in the pre-Eddington picture, with radiative transfer through the stellar atmosphere, studied by Eddington and Milne, yielding a new M—L—R relation. In most main-sequence stars, the photosphere is passive, radiating the energy supplied from below, but does not react back strongly on the structure of the star. In the highly evolved giant stars, studied by Hoyle and Schwarzschild, the analogue of Eddington's prescription applies to the central regions with a burnt-out degenerate core surrounded by an energy-generating shell; but now the photospheric conditions require the stellar envelope to be largely convective.

Eddington's treatment of main sequence stars does not apply to the white dwarfs. Sirius B has M ≈M , but L ≈ L /300; yet its surface temperature is ≈8000 K, similar to that of Sirius A, yielding R ≈ R /30 and so a mean density of “a ton to a cubic inch”. Within classical physics, this dense body, in Eddington's words, is “continually losing heat but has insufficient energy to grow cold!”. The paradox was resolved by Fowler's application of the Pauli Exclusion Principle to the effectively free, “degenerate”, non-relativistic electron gas, which exerts a huge zero-order pressure, able to balance gravity. A finite-temperature white dwarf cools slowly towards the cold “black dwarf” state.

When the special relativistic energy-momentum relation is used, the resulting Stoner—Anderson—Chandrasekhar pressure-density law does not allow a cold body to form if its mass exceeds the Chandrasekhar limit, MCh≈ 1.44M . A burnt-out star of super-critical mass continues radiating and contracting until it becomes what is nowadays called a black hole. Eddington regarded this as a “reductio ad absurdum of the relativistic degeneracy formula”. In the ensuing controversy, Eddington made some penetrating criticisms of some of the published treatments, but his arguments that the Fowler formula remained valid for all masses failed to carry conviction. Relativistic degeneracy, combined with the general-relativistic nonlinearities, remains an essential feature of stellar evolution, allowing the synthesis of the heavier elements, the formation of neutron stars, and collapse into stellar mass black holes. (Accessed 10.06.2023)

(Accessed 10.06.2023)

https://www.researchgate.net/publication/349849411_The_Eddington_Regener_and_McKellar_Measurements_of_an_Equivalent_Temperature_of_Interstellar_Space

In this paper we will analyze the cosmic effective temperatures outlined by the Englishastronomer Sir Arthur Eddington in 1926 and by the German physicist Erich Regener in the1930’s. We shall compare this to the temperature measurement made by the Canadianastronomer Andrew McKellar in the 1940’s, and some of the later CMBR measurement . (accessed 10.06.2023)

(Accessed 10.06.2023)

Why is this MRB temperature so very uniform? This was a problem for Steady State theorists to explain in the 1960′s and 70′s. They turned to macrophysics for their explanation. They said that a molecular form of iron and possibly carbon could absorb and reradiate these low temperatures and frequencies easily and uniformly. And with an infinitely old universe that they proposed, there would be ample time for temperature caramelization and uniformity. Opponents called this an ad hoc (iron whiskers) proposal, and that such prevalent atomic and molecular forms and the even distribution of them was highly unlikely.

Not discounting the explanation of MBR temperature uniformity relating to absorption and re-radiation by matter, there are other more modern micro physics explanations that could cause or assist in this temperature uniformity. The first is that all matter in motion produces De Broglie waves. These waves relate to relative motion and oscillations of matter via their temperature, and also theoretically can involve particle spin. Via the outward radiation of these waves, a form of conduction exists to other matter since the field absorbs this energy; it is not lost. Secondly, surrounding matter virtual-particle oscillations proliferate to a greater extent than they do in the absence of matter. This can also be another form of energy production, absorption, and conduction of energy by the background Zero Point Field concerning the MBR generated from the surrounding matter. All could be forms of energy absorption and temperature conduction to a generally uniform blackbody radiation.

2.3.1 Steady-state cosmologies in general

The most well-known of the alternative cosmologies was the Steady State cosmology (SS) of Fred Hoyle, Gold, and Bondi, 1948, which had many followers until the late 1960's, [1]

Comparing the SS model with the BB model, one primary difference between the two is that the SS model proposes the continuous creation of new matter. The reason for this requirement is that in an expanding universe model, the universe would have been progressively denser in the past. But this was not what SS astronomers believed they were seeing. In their view the past universe appeared to have been less dense than the present, but because of the great distances that apparent difference was easily explainable. And since then there has never been acknowledged observations of a denser universe in the past, even though it is a quintessential requirement of the ΛCDM theory.

The three primary reasons why the BB won the battle for cosmology dominance are as follows: First were the observations that quasars and some types of radio galaxies only exist at great distances, a few close by. This relates to an evolving universe proposed by the BB model. The second reason related relates to the observed abundance of light elements, which can't be explained by nuclear fusion theory. The BB model proposed a theoretical physics mathematical explanation based upon an original BB event, which assertedly created this abundance. The third reason was the 1964 discovery of the microwave background radiation that was assertedly predicted before its discovery. This discovery was also explainable by SS cosmology but its almost complete uniformity was difficult to explain via SS cosmology.

All three reasons are explained in further detail within this paper. More recent observations indicate a number of problems with both theories concerning the uniformity of the universe as explained in the above link. These involve violations of the cosmological principle, which include both violations of isotropy and of homogeneity. Although these observations contradict both theories, most believe these observation anomalies put a bigger pressure on the SS model because it asserts a non-evolving universe. Others argue that it puts more pressure on the ΛCDM model because it is the accepted mainstream model. This lack of universe uniformity is explained in the link above.

3. The alternative: The Pan Theory of Cosmology (PTC)

The discussion of the Pan Theory of Cosmology starts with a brief explanation of the Pan Theory itself, which could be summarized as a different theory of modern physics. It is a 350+ page long online book that is found in this link. [11]. http://www.pantheory.org/

Although the majority of this theory and its theoretical physics are cosmology related, a 70 page-long "Theory of Everything" was written based upon its tenets, here:

https://www.researchgate.net/publication/353588675_Theory_of_Everything

And also a "Grand Unified Theory" here:

https://www.researchgate.net/publication/355132702_A_Grand_Unified_Theory

The Pan Theory of Cosmology (PTC) is also a theory of Cosmogony (explaining the very beginning of the universe). Explanations of the very beginning of the universe have been deleted from Big Bang cosmology because of the singularity problem and the indeterminable means of its beginning – which now allows for many different possible beginnings.

The PTC can also be classified as a "steady-state theory" because accordingly the observable universe would not be evolving. This model proposes **the Perfect Cosmological Principle,** which states that the universe is the same at all times, as well as in all places. When classified as a steady state theory, it is still quite different from Hoyle's Steady-State theory. The PTC proposes a vastly older universe but one still finite in age, matter, and space. To explain redshifts, it proposes instead the slow diminution of matter (5) over billions of years rather than the expansion of space, which can be viewed as the same thing relatively speaking. In this way it also can be considered a simple "scale changing theory."

The PTC proposes the diminution of matter instead of the expansion of space to explain the observed redshifts. Like Hoyle's theory it proposes the creating of new matter, but instead from the decrement resulting from the diminution of matter, created at the base and within AGN jets. The process of the creation of new matter has been conducted in labs, and requires a great deal of energy. Besides the huge energy in galactic jets and AGN nuclei, the PTC also proposes that the ZPF is made up of physical field material that can be made into matter. The process is as follows:

To create electron positron pairs gamma rays are directed toward each other. At their intersection electron—positrons pairs are created.

As to the process of proton-antiproton creation:

"The process of electron—positron annihilation into proton—antiproton pairs is considered within the vicinity of ψ (3770) resonance. The interference between the pure electromagnetic intermediate state and the ψ (3770) state is evaluated. It is shown that this interference is destructive and the relative phase between these two contributions is large ($\phi 0 \approx 250^o$).” [24]

https://www.sciencedirect.com/science/article/pii/S0550321314002971

The Pan Theory of Cosmology (PTC): reflecting back to the potential problems of mainstream cosmology, above

At this point in our discussion we will go back to “the list of the more well-known problems of mainstream cosmology,” 2.2 above, sometimes providing more detail and reasons for the above answers based upon the PTC. The list of problems begins with Dark Matter and Dark Energy. These are not considered problems of mainstream cosmology because both have been integrated into mainstream theory. The problem is that the essence of neither is known. Is Dark Matter a form of non-baryonic matter as presently believed, even though it has never been directly observed? And what is Dark Energy? Is it Einstein’s cosmological constant Lambda, as many believe, or is it something else? The answers to these problems/ questions given above are based upon the PTC, explained in further detail below.

Dark Matter, the answer given above was:

… the additional force influence within spiral galaxies and galaxy clusters that increase stellar velocities is instead a flowing vortex pushing force of the background field, the Zero Point Field, a presently unrecognized force and explanation. The equations result in “calculations that exactly match observations.” Related observations are also given in the link below. (15)

https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3.

> In our recent report, observational evidence supports that the rotational direction of a galaxy tends to be coherent with the average motion of its nearby neighbors within 1 Mpc. We extend the investigation to neighbors at farther distances in order to examine if such dynamical coherence is found even in large scales. The Calar Alto Legacy Integral Field Area (CALIFA) survey data and the NASA-Sloan Atlas (NSA) catalog are used.
>
> From the composite map of velocity distribution of "neighbor" galaxies within 15 Mpc from the CALIFA galaxies, the composite radial profiles of the luminosity-weighted mean velocity of neighbors are derived. These profiles show unexpectedly strong evidence of the dynamical

> coherence between the rotation of the CALIFA galaxies and the average line-of-sight motion of their neighbors within several-megaparsec distances. Such a signal is particularly strong when the neighbors are limited to red ones: the luminosity-weighted mean velocity at $1 < D \leq 6$ Mpc is as large as 30.6 ± 10.9 km s^{-1} (2.8σ significance to random spin-axis uncertainty) for central rotation ($R \leq Re$).
>
> In the comparison of several subsamples, the dynamical coherence tends to be marginally stronger for the diffuse or kinematically well-aligned CALIFA galaxies. For this mysterious coherence in large scales, we cautiously suggest a scenario in which it results from a possible relationship between the long-term motion of a large-scale structure and the rotations of galaxies in it. (Accessed 10.06.2023)

Few know that Dark Matter is a very poor predictor of velocities in spiral galaxies. Only those who have studied it are familiar with the almost complete failings of dark matter predictions in this venue. But those who have studied it also know that modified-gravity models have their own problems trying to explain the velocities of galaxies in a cluster and gravitational lensing. [2]

But for the PTC, we believe the related theory and equations that exactly match observations will be the primary factor that could bring this theory into prominence once their unmatched accuracy is recognized. And if the PTC would ever challenge mainstream cosmology in the minds of many, we believe the Background Field Flow theory and equations would be the primary reason. [3]

Dark Energy: The answer given above was: … (dark matter's) supposed existence is based upon the inaccuracy of the Hubble distance formula, which is assertedly wrong by at least 10% when calculating redshift distances at z ~ .6 when calculated by the alternative cosmology's equation– as explained in the link below.

https://pdfs.semanticscholar.org/18af/86eb09dbf86df826906392e2eb4c9f876d8d.pdf

> The purpose of this research and study was to help derive and test new theoretical equations to accurately determine cosmological distances and luminosities for all cosmological entities without the need for the dark energy hypothesis. These derived equations were based upon an alternative cosmological model and a study of type 1a supernovae observation data.
>
> This paper presents the results of this research and study and the resultant new equations. A new distance equation is presented in this paper for peer consideration for the first time. It is proposed as an eventual replacement for the Hubble distance formula concerning calculated cosmic distances based upon redshifts. A new "brightness equation" is also offered herein. Its calculations are required to accompany the calculations of the distance equation to determine brightnesses and are proposed as an addendum to the inverse square law of light concerning

> luminosity calculations for cosmic-redshifted distances. In the subject supernova study these alternative equations are used to show their application and proposed validity concerning calculated distances and observed brightnesses of type 1a supernovae.
>
> The proposed alternative distance equation is very different from the Hubble distance formula since it is directly linear and was derived from an entirely different non-expanding-universe cosmology, tested and refined based upon a study of type 1a supernova data involving the subject applied physics research.
>
> Explanations of the alternative cosmological model are presented here for the consideration of their merits. Hopefully these proposed equations will be tested by many others concerning all types of cosmological-distance observations of redshifts requiring distance and brightness-determination calculations, eventually resulting in the serious consideration of the subject cosmological model for reasons discussed in this paper. (Accessed 10.06.2023)

After this information is known, very logical questions arise. What caused dark energy in the first place about 6 billion year ago? There is no known answer to this. What is more likely, that the Hubble distance formula is simply wrong and under-calculates distances by at least 10% at a redshift of Z ~.6, or concluding that the universe contains 70% more energy than that, which is observable. One would think that the simpler answer is the better answer.

And now there's the Hubble Constant controversy, a most important part of the Hubble equation.

The Hubble Constant Controversy: As explained above, this problem is threefold. The most important part of the problem is that regardless of the Hubble constant used, the formula is assertedly wrong and miscalculates. The second problem is that different methods calculate different values for the Hubble Constant. And the third problem is also a very serious one in that it implies that present interpretations of the microwave background radiation are wrong since they are based upon theory, and the results don't agree with direct measurements of the supposed expansion of space.

Not to reiterate what was explained above concerning the Hubble Constant Problem now called the Hubble Crises on page 4, we assert that the much bigger problem is that the entire Hubble distance formula, where this constant is a part of, is simply wrong and needs to be replaced. Another prime example of this are the observations of the James Webb Space telescope showing that fully formed mature looking galaxies appear to exist at the supposed beginning of the universe, only 300 million years old. Only 300 million years old and at the beginning of the universe is solely based upon calculations of the Hubble distance formula. The alternative distance formula of the PTC is called the Pan Theory distance formula. It has no age or distance limit to it as seen the link below. With this formula there is no dark energy, no Hubble constant problem, and no seeming galactic age contradictions by the James Webb or any other telescope or array.

The Fine Tuning Problem: This is more a problem of particle physics than of Cosmology. This problem relates to what the mainstream believes are "free parameters", which are not free at all According to the Pan Theory (APT). They are all interdependent and depend upon presently unknown conditions of reality. Examples are: the Gravitational force constant, the Electromagnetic force constant, the Strong nuclear force constant, and the Weak nuclear force constant. These forces are inter-related in the following way according to the Pan Theory's Grand Unified Theory, and are not free parameters.

https://www.researchgate.net/publication/355132702_A_Grand_Unified_Theory

Other so-called free parameters are the speed of light, which may be dependent on the density of the background field, the ratio of the masses of neutrons to protons, which are related to nuclear fusion and decay theory, etc. None of these or any other so called free parameters are independent. The entire argument is based upon present-day ignorance of the facts and detail APT.

Instead of the free parameters of nature being fine-tuned for life, the opposite is true. Life originates and evolves based upon the chemistry and conditions of the parameters that precede it.

Origin and future of the universe: How did the conditions arise that resulted in the creation and formation of the universe in the first place?

This is not a problem that requires an answer for the Pan Theory of Cosmology, or any other cosmology that does not assume that there were conditions of reality that preceded the universe. Accordingly there was no creation event for the universe. The universe contains a dimension, which perpetuates time, particle spin, and change, which continues to this day. The Pan Theory describes this "dimension" as an unwinding, rewinding process, which can be observed as particle spin. [14]

Does the Universe evolve and if so how, and what is its future? According to the Pan Theory of Cosmology the universe does not evolve as a whole. Of course there are local evolution cycles of galaxies and galaxy clusters etc. If there is no evolution, then the future of the universe will just be a bigger one of continued density based upon the diminution of matter and new-matter creation primarily based upon creation events at the base of galactic black holes, and within their jets. Stephan Hawking proposed such creation events, but on a small scale, which are called Hawking radiation.

Hawking's Radiation

http://www.scholarpedia.org/article/Hawking_radiation

> Hawking radiation is the thermal radiation predicted to be spontaneously emitted by black holes. It arises from the steady conversion of quantum vacuum fluctuations into pairs of particles, one of which escaping at infinity while the other is trapped inside the black hole horizon. It is named after the physicist Stephen Hawking who derived its existence in 1974. This radiation reduces the mass of black holes and is therefore also known as black hole evaporation.
>
> Black hole formation. There are two kinds of black holes in the Universe: those of stellar origin of a few solar masses, and those found in globular clusters or in galactic nuclei. The second are much more massive; their masses vary between a few hundred and a billion solar masses. The first type is better known, and we briefly review how they form. When a sufficiently massive star has burned its nuclear material, its internal pressure is no longer able to resist its own gravitational attraction. As a result, the star implodes. The outer layers bounce off the inner ones and a large fraction of the star's matter is ejected at a speed on the order of a few percent of the speed of light c . The star undergoes a supernova. It will then contract and, if the residual material is not too massive, a new equilibrium state will be reached: a neutron star. But if the mass is greater than a few solar masses, the pressure will not be able to counterbalance its weight. It will thus ineluctably keep collapsing and form a black hole.
>
> Black hole horizon properties. From a more geometric point of view, in the theory of general relativity, a black hole is a region of space-time characterized by a boundary called the horizon that separates the outer region -– from which light rays can escape and reach far distant observers -– from the trapped region -– from which neither matter nor light can possibly escape (see Figure 1 and). The simplest example is a stationary, non-rotating black hole. In this case, at each instant, the horizon is the surface of a sphere. Its area is equal to 4πr2S , where the Schwarzschild radius rS is related to the black hole mass M by rS=2GMc2,(1) where G is Newton's gravitational constant =6,674×10−11m3kg−1s−2 . For a one solar mass black hole, rS is approximately equal to 3km , i.e. much smaller than the present radius of the Sun which is of the order of 7×105km .

> When considered at all times, the horizon forms a three-dimensional cylinder (embedded in the four dimensional space-time) whose base is the spherical surface we just discussed, and whose third dimension do straight lines engender. What is peculiar about these lines is that they are part of some future light cones, as can be seen in Figure 1. (In relativistic jargon, they are called "null" lines because the space-time distance between any two points of one of them is exactly zero.) More precisely, these lines are the outermost generators of the forward light cones whose vertices are situated on the horizon itself. Because of the curvature of the black hole space-time, these lines stay on the surface of fixed area 4πr2S instead of spreading from each other, as it is the case in flat space-time. In this sense the black hole horizon is static and eternal.
>
> More physically, the above results imply that no light rays emitted from these vertices could possibly propagate outwards, i.e. with increasing values of the radial coordinate r . The best they can do is to slide at fixed r=rS , along the horizon. (Accessed 10.06.2023)

Cosmic Inflation: Is the theory of cosmic inflation in the very early universe correct? This simple answer to this question is no, as also explained above. No steady state density model would have need for such a proposal.

Horizon and Flatness problems: Neither the PTC or any steady state density cosmology would have a horizon of flatness problem concerning the observable universe.

Size of the universe: The diameter of the observable universe, according to BB theory, is about 93 billion light-years in diameter, but what is the size of the whole universe? This is no problem for the PTC or any steady state model in that the universe would either be infinite or of an unknowable size, as would be the case for the PTC. Some would also assert that an unknowable size would also apply to the ΛCDM universe.

Baryon asymmetry: Why is there far more matter than antimatter in the observable universe? Could this be due to the asymmetry of longevity between matter and antimatter? As explained above, yes, this is the correct answer.

Cosmological principle: Is the universe homogeneous and isotropic at the largest scales? Yes but the Friedmann–Lemaître–Robertson–Walker metric would not apply whether by the expansion of space as in the ΛCDM model, or by the PTC diminution of matter model where field flow forces dominate gravity.

<u>Cosmological constant problem</u>: Why does the zero-point energy of the vacuum not cause a large cosmological constant? What cancels it out? The possible outward pushing forces of the Zero Point Field due to internal energy, is canceled out by the inward pushing forces, which we call gravity.

<u>The Dark flow</u>: Are the galactic motions of this flow due to the gravitational pull from outside the observable universe responsible for some of the observed motion of large objects such as galactic clusters in the universe? The answer is no. This flow is instead due to the fractal nature of the universe and relates more to a prior expired era of the universe.

<u>Shape of the universe</u>: What is the "shape" of the universe? The universe is simply flat. There is no physical fourth dimension form or warped-space to it. The universe is generally spherical in form with three-dimensional boundaries. Space is simply the distance between matter and the volume that matter and field occupy and nothing more. Space does not exist beyond the boundaries of matter and field by this definition.

<u>Are the Largest Structures of the universe contrary to mainstream cosmology?</u> The Sloan Great Wall is 1.38 billion light-years in length, and the largest structure currently known, the Hercules–Corona Borealis Great Wall. Are these actual structures, or just random density characteristics? Yes, and they all relate to forms of a somewhat fractal universe.

https://en.wikipedia.org/wiki/Shape_of_the_universe

The Cosmic Density Problem and the Too-Thin universe problem: [7]

The shape of the universe, in physical cosmology, is the local and global geometry of the universe. The local features of the geometry of the universe are primarily described by its curvature, whereas the topology of the universe describes general global properties of its shape as a continuous object. The spatial curvature is described by general relativity, which describes how spacetime is curved due to the effect of gravity. The spatial topology cannot be determined from its curvature, due to the fact that there exist locally indistinguishable spaces that may be endowed with different topological invariants.

Cosmologists distinguish between the observable universe and the entire universe, the former being a ball-shaped portion of the latter that can, in principle, be accessible by astronomical observations. Assuming the cosmological principle, the observable universe is similar from all contemporary van-

> tage points, which allows cosmologists to discuss properties of the entire universe with only information from studying their observable universe. The main discussion in this context is whether the universe is finite, like the observable universe, or infinite. Several potential topological and geometric properties of the universe need to be identified. Its topological characterization remains an open problem. (Accessed 10.06.2023)

Why does the universe appear to be too thin in the past? The ΛCDM universe requires a much denser past to verify the expansion of space. Numerous studies have asserted that the universe of the past was not dense enough to confirm the expansion of space, to have created all the observed galaxies, galaxy clusters, or the observed cosmic web. This problem is called the **cosmic tension.**

https://www.quantamagazine.org/a-new-cosmic-tension-the-universe-might-be-too-thin-20200908/

> The cosmos is starting to look a bit weird. For a few years now, cosmologists have been troubled by a discrepancy in how fast the universe is expanding. They know how fast it should be going, based on ancient light from the early universe, but apparently the modern universe has picked up too much speed — a clue that scientists might have overlooked one of the universe's fundamental ingredients, or some aspect of how those ingredients stir together.
>
> Now a second crack in the so-called standard model of cosmology may be forming. In late July, scientists announced that the modern universe also looks unexpectedly thin. Galaxies and gas and other matter haven't clumped together quite as much as they should have. A few earlier studies offered similar hints, but this new analysis of seven years of data represents the cleanest stand-alone indication of the anomaly yet.
>
> "If we were having conferences," said Michael Hudson, a cosmologist at the University of Waterloo in Canada who is not involved in the research, "all the coffee chatter would be about these results."
>
> Like most measurements of the large-scale structure of the present-day universe, the study is fraught with technical difficulties. It's also possible, though unlikely, that the results are due to chance. Nevertheless, some researchers wonder if the trend toward increasingly funky measurements may foreshadow the discovery of a new cosmic agent. "We've already got dark matter and dark energy," Hudson said. "I hope we don't need another dark thing."
>
> (Accessed 10.06.2023)

For the PTC, background field flow would be a much faster agent for the creation of the observed structures than gravity.

<u>The Predicted abundance of light elements:</u> — this theoretical physics was based upon the known abundance of the light elements at that time. Its predictions were hypothesized based upon a single Big Bang event, which is no longer part of the theory. For this reason any further use of this theory would be a further revelation of its ad hoc nature enabling any competing theory to possibly come to equal or better predictions by their own ad hoc proposal. For the PTC, the entities of this creation would be galactic black holes and their Jets. [23]

The Axis of evil: Some large features of the microwave background are supposedly coming from events believed to have happened over 13 billion years ago, but they appear to be aligned with both the motion and orientation of the solar system. What is the reason for this? The biggest problem of this proposal is that it must be assumed that no part of the observed MBR, 2.7K degrees, is the temperature of our galaxy. If not, where can we find the temperature of the atomic and fine-grained matter of our galaxy? If our galaxy's temperature is a part of this MBR temperature then; why not the whole of it, which would explain the so-called axis of evil.

3.1 The Beginning Universe, According to the Pan Theory APT

The universe began as a beginning entity similar to the original Big Bang theory explanation. But unlike the BB entity, this entity would have been very simple in form and character, and its changing would have been extremely slow over countless billions of years. For the Pan Theory, this beginning entity is called a "pan," (pan, meaning everything in Greek), and also the only most fundamental particle that exists, concerning the PTC. It only changed / changes in form very slowly. So the time span concerning the beginning of the universe was generally incalculable concerning the entire universe APT. The minimum time period calculated to create the observable universe via the Pan Theory was more than a trillion years rather than billions of years, and then only to come to the time period where the first stars and galaxies began to form. Accordingly humanity would not only be lost in space, but also lost in time – concerning our relative position in each.

3.2 Characteristics of the Pan Theory of Cosmology (PTC)

3.2.1 A Diminution of matter theory (matter getting smaller over very long time periods)

The PTC can be considered a steady state theory, and is also a diminution of matter theory. Robert Dicke proposed the first published diminution of matter scientific theory in 1956. [17] His diminution of matter model was based upon gravity as its cause. The idea of these theories collectively is that if matter were slowly getting smaller over time, then it would appear to us that the universe was expanding. We would see exactly the same redshifts of galaxies. As simply a condition of relativity, space getting larger relative to matter, or matter getting smaller relative to space would be exactly the same thing. But if the condition were not just relative but real somehow, then there could be a difference between the theories theoretical physics and mathematics involved – which would be the case for the PTC.

In addition to his Steady State theory, Fred Hoyle along with Jayant Narlikar, proposed a matter diminution model in the 1960's (electrons getting closer to atomic nuclei) to explain the observed redshifts of galaxies rather than the expansion of the universe or of space. A few lesser-known diminution of matter theories has also been proposed over the decades since the 1960's. Some are called scale-changing theories, and others called Scale Relativity theory. [12] Nearly all of these have a dominant mathematical basis. The Pan Theory of Cosmology proposes just a simple diminution rate over time, which mathematically would be like the Hubble constant.

For the Pan Theory, the diminution of matter process is based upon an unwinding-rewinding process of matter, as observed in the spin of fermions. APT: The rate of change whereby matter would be getting smaller is about 1,000th part every 6-7 million years. Also, new matter would be steadily created (electrons, protons, and their anti-particles) from the matter decrement to the Zero Point Field. From this higher field density this new matter would be created, maintaining a generally constant density of matter and a steady-state condition of the universe, conserving both matter and energy. The Pan Theory hypothesis explains the process of new matter creation mostly involving very active galactic nuclei having polar jets, where new matter would be created from the foundation materials in the Zero Point Field (ZPF), the simplest elements of which are called a pan in the PTC.

The PTC also proposes, presently unknown background field flow of the ZPF as being a greater influence than gravity concerning the large scale formation and structures of the universe. A prime example of this unknown force is presently called the "dark flow," but APT, field flow is happening everywhere at all times at the largest scales of the universe. Although observed by a number of astronomers and discussed as an unknown effect in galaxy clusters, it is primarily attributed to non-baryonic dark matter or unknown galaxy cluster processes. It remains an unknown observation anomaly to astronomers and theorists, and probably will remain so for awhile since the time required for studying an entire galaxy cluster is extensive to enable any conclusion at all, right or wrong, as in the link below and the cluster's related analyses.

https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3/pdf

> In our recent report, observational evidence supports that the rotational direction of a galaxy tends to be coherent with the average motion of its nearby neighbors within 1 Mpc. We extend the investigation to neighbors at farther distances in order to examine if such dynamical coherence is found even in large scales. The Calar Alto Legacy Integral Field Area (CALIFA) survey data and the NASA-Sloan Atlas (NSA) catalog are used.
>
> From the composite map of velocity distribution of "neighbor" galaxies within 15 Mpc from the CALIFA galaxies, the composite radial profiles of the luminosity-weighted mean velocity of neighbors are derived. These profiles show unexpectedly strong evidence of the dynamical coherence between the rotation of the CALIFA galaxies and the average line-of sight motion of their neighbors within several-mega parsec distances.
>
> Such a signal is particularly strong when the neighbors are limited to red ones: the luminosity-weighted mean velocity at 1 < D   6 Mpc is as large as30.6 ± 10.9 km s−1 (2.8σ significance to random spin-axis uncertainty) for central rotation (R „ Re). In the comparison of several subsamples, the dynamical coherence tends to be marginally stronger for the diffuse orkinematically well-aligned CALIFA galaxies. For this mysterious coherence in large scales, we cautiously suggests scenario in which it results from a possible relationship between the long-term motion of a large-scale structure and the rotations of galaxies in it. (Accessed 10.06.2023)

The (PTC): This cosmology also proposes a model of pushing gravity that does not contradict the equations of General Relativity but adds its own field-flow addendum equations to gravity to calculate the additional velocities of stars in spiral galaxies, which are now attributed to the existence of Dark matter. It should be realized that gravity does not increase escape velocities; it just applies forces against them. It also has its own equations to calculate galactic distances, ages, brightnesses, etc. At the greatest observable distances these calculations yield distances and brightnesses many times greater than mainstream cosmology, more in line with JWST observations since there is no distance limit.

Background Field Flow of the Zero Point Field:

https://www.researchgate.net/publication/365488325_Background_Field_Flow_Dynamics_of_the_Zero_Point_Field#fullTextFileContent

3.2.2 The Pan Theory of Cosmology continued: the non-expanding universe

The Pan Theory proposes that galactic redshifts are caused by a diminution of matter process rather than the expansion of space. Space would appear to be expanding from our perspective but instead matter would be very slowly getting smaller, a type of scale-changing or scale-relativity theory.

https://handwiki.org/wiki/Physics:Scale_relativity

> Relativity theories (special relativity and general relativity) are based on the notion that position, orientation, movement and acceleration cannot be defined in an absolute way, but only relative to a system of reference. The scale relativity theory proposes to extend the concept of relativity to physical scales (time, length, energy, or momentum scales), by introducing an explicit "state of scale" in coordinate systems. This extension of the relativity principle using fractal geometries to study scale transformations was originally introduced by Laurent Nottale, based on the idea of a fractal space-time theory first introduced by Garnet Ord, and by Nottale and Jean Schneider. The construction of the theory is similar to previous relativity theories, with three different levels: Galilean, special and general. The development of a full general scale relativity is not finished yet. (Accessed 10.06.2023)

With larger matter and measuring sticks in the past, we would also measure the distances of space as having been greater in the past, compared to the present. If distances would measure greater, then the rate that time passed would have to have been slower (time dilation) for the speed of light to remain the same in the past as it is now – via distances traveled per second.

3.2.3 The universe would be far older, but not infinite in time past or size

APT, the universe had a beginning. Therefore the Pan Theory is a type of non-infinite steady state theory proposing a totally flat universe. Via the Zero Point Field, it is also an aether proposal like Einstein's little-known proposal, which he called "Aetheory," and Paul Dirac's proposal that the quanta vacuum (ZPF) could be the modern-physics equivalent of the particulate aether proposals of the 19th century.

https://en.wikipedia.org/wiki/Einstein_aether_theory

Einstein-aether theories were popularized by Maurizio Gasperini in a series of papers, such as Singularity Prevention and Broken Lorentz Symmetry in the 1980s. In addition to the metric of general relativity these theories also included a scalar field which intuitively corresponded to a universal notion of time. Such a theory will have a preferred reference frame, that in which the universal time is the actual time. The dynamics of the scalar field is identified with that of an aether which is at rest in the preferred frame. This is the origin of the name of the theory; it contains Einstein's gravity plus an aether.

Einstein aether theories returned to prominence at the turn of the century with the paper Gravity and a Preferred Frame by Ted Jacobson and David Mattingly. Their theory contains less information than that of Gasperini, instead of a scalar field giving a universal time it contains only a unit vector field which gives the direction of time. Thus observers who follow the aether at different points will not necessarily age at the same rate in the Jacobson–Mattingly theory.

The existence of a preferred, dynamical time vector breaks the Lorentz symmetry of the theory, more precisely it breaks the invariance under boosts. This symmetry breaking may lead to a Higgs mechanism for the graviton which would alter long distance physics, perhaps yielding an explanation for recent supernova data which would otherwise be explained by a cosmological constant.

The effect of breaking Lorentz invariance on quantum field theory has a long history leading back at least to the work of Markus Fierz and Wolfgang Pauli in 1939. Recently it has regained popularity with, for example, the paper Effective Field Theory for Massive Gravitons and Gravity in Theory Space by Nima Arkani-Hamed, Howard Georgi and Matthew Schwartz. Einstein-aether theories provide a concrete example of a theory with broken Lorentz invariance and so have proven to be a natural setting for such investigations. In 2004, Eling, Jacobson and Mattingly wrote a review of the status Einstein aether theory as of 2004. (Accessed 10.06.2023)

https://en.wikipedia.org/wiki/Aether_theories

> Isaac Newton suggests the existence of an aether in the Third Book of Opticks (1st ed. 1704; 2nd ed. 1718): "Doth not this ethereal medium in passing out of water, glass, crystal, and other compact and dense bodies in empty spaces, grow denser and denser by degrees, and by that means refract the rays of light not in a point, but by bending them gradually in curve lines? ...Is not this medium much rarer within the dense bodies of the Sun, stars, planets and comets, than in the empty celestial space between them? And in passing from them to great distances, doth it not grow denser and denser perpetually, and thereby cause the gravity of those great bodies towards one another, and of their parts towards the bodies; every body endeavoring to go from the denser parts of the medium towards the rarer?"
>
> In the 19th century, luminiferous ether (or ether), meaning light-bearing aether, was a theorized medium for the propagation of light. James Clerk Maxwell developed a model to explain electric and magnetic phenomena using the aether, a model that led to what are now called Maxwell's equations and the understanding that light is an electromagnetic wave. However, a series of increasingly complex experiments had been carried out in the late 1800s like the Michelson–Morley experiment in an attempt to detect the motion of Earth through the aether, and had failed to do so. A range of proposed aether-dragging theories could explain the null result but these were more complex, and tended to use arbitrary-looking coefficients and physical assumptions. Joseph Larmor discussed the aether in terms of a moving magnetic field caused by the acceleration of electrons.
>
> Hendrik Lorentz and George Francis FitzGerald offered within the framework of Lorentz ether theory an explanation of how the Michelson–Morley experiment could have failed to detect motion through the aether. However, the initial Lorentz theory predicted that motion through the

aether would create a birefringence effect, which Rayleigh and Brace tested and failed to find (Experiments of Rayleigh and Brace). All of those results required the full application of the Lorentz transformation by Lorentz and Joseph Larmor in 1904. Summarizing the results of Michelson, Rayleigh and others, Hermann Weyl would later write that the aether had "betaken itself to the land of the shades in a final effort to elude the inquisitive search of the physicist". In addition to possessing more conceptual clarity, Albert Einstein's 1905 special theory of relativity could explain all of the experimental results without referring to an aether at all. This eventually led most physicists to conclude that the earlier notion of a luminiferous aether was not a useful concept. (Accessed 10.06.2023)

3.2.4 ***Observations should reveal that the most distant galaxies were (and also looked) the same in the past as in present local universe;*** a steady-state model – which is now what we believe is being observed now by the James Webb Space Telescope.

3.2.5 *Characteristics that distinguish the Pan Theory of Cosmology from other steady state theories*

The most obvious differences between the Pan Theory and other steady state (SS) theories is that the universe is not infinite, space is not expanding, and its distance and brightness equations yield different results than other SS theories. It explains both the reasons and equations necessary to contradict the existence of both dark matter and dark energy. Unlike alternative-gravity models that require additional unseen matter to explain the velocities of galaxies in a cluster, the Pan Theory requires no additional matter, only background field flow of the Zero Point Field, which is not difficult to understand, even though its theory is not generally known by mainstream astronomers and cosmologists. This field flow is known by astronomers and theorists to follow matter, or the cosmological principle would no longer apply. But the PTC also proposed that it instead leads matter toward a center of gravity like gravity does. But instead of moving at the speed of light like gravity, it moves at the speed of stars in a galaxy, and at the speed of galaxies in a cluster. This field has variations in density and field flow. The farther away from matter the higher the density of the field and the slower the field flow. The process is explained in detail in this link.

https://www.researchgate.net/publication/353700439_Theory_of_Everything_14#fullTextFileContent

(Sections 12.0 to 12.6)

Above, we discussed that the BB model proposes the evolution of the universe over time. The universe therefore should have looked different in the past according to BB theory. Examples, which we discussed were AGN radio galaxies and quasars. The range of these galaxies distances vs. their redshifts will be discussed later in this section.

3.3 *Observations interpreted by mainstream astronomers and theorists, which would be difficult for the Pan Theory of Cosmology to explain* – like the Big Bang problems listed above, but a very short list.

3.3.1 *Quasars and AGN Radio galaxies explained by the Pan Theory of Cosmology*

It wasn't realized until the late 1970's that quasars and some radio galaxies are focused jets of light and matter, created by Active Galactic Nuclei (AGN) at Galactic Super-Massive-Black-Hole (SMBH) centers of large galaxies. Before then they were thought to be unique unexplained entities. Upon better understandings, they were then used to defend the evolving universe of the BB model.

Roughly speaking, most quasars are also radio galaxies, with one their galactic jets focused in our direction, while radio galaxies that have jets are not focused toward us. Both are presently believed to stem from polar jets of active galactic nuclei, AGN. The graphs to be discussed below show the highest frequency of quasars are at a redshift of about z = 2. Radio galaxies of this same type are of a much greater frequency but not focused in our direction. Quasars were first discovered as radio galaxies before their visible spectra were later discovered. Some radio galaxies at an observable angle reveal the full view of their opposite polar jets, perpendicular to the axis of rotation of the SMBH that generates them. The nearest quasar to date has a redshift of .056, and the farthest observable quasar, at a redshift was (2017) z = 7.64, and now a contender at a redshift greater than 10 is believed to exist. With redshifts greater than 6 Quasars would probably contradict BB cosmology, in such an assumed early era of the universe (as will be explained below).

Like the famous astronomer Halton Arp and others having the same ideas originally proposed and the PTC also proposes, that the distances to some or many quasars cannot be accurately determined by their redshifts alone since the redshifts of at least some of them would have an intrinsic character to them causing their distances to be incorrectly overestimated. If so then at least some quasars would be much closer than what their redshifted spectra would indicate. And if so, what could be these intrinsic characteristics be, based upon the PTC?

The possible answers are not necessarily part of PTC so they could be considered preferred hypothesis regarding possible alternative distance determinations to these AGN quasar galaxies, since we believe in time these hypotheses will gain or lose support via new evidence.

Why are these proposals being discussed here at all? Because the PTC and all other steady state theories would have to explain that the universe was the same in the past and does not evolve as a whole. But the distances attributed to quasars and radio galaxies based upon their redshifts, contradict an evenly distributed, isotropic universe. So such explanations are needed like those of the astronomer Halton Arp, who attributed some quasar and galactic redshifts to intrinsic redshifting of some sort.

3.3.1.1 Quasars and AGN Radio galaxies

The first proposed hypothesis is the well-known effect called gravitational redshifting. [18] The center of our sun, for instance, is slightly more redshifted than the rest of the sun's spectra. The force of gravity slightly stretches the sun's spectra of EM radiation at its gravitational center of our line of sight.

Gravitational redshift:

https://www.space.com/einstein-gravitational-redshift-observed-double-star-system.html

> Gravitational redshift, an effect predicted by Albert Einstein that is crucial for maintaining the Global Positioning System (GPS) on Earth, has been observed in a star system in our galaxy.
> Within Einstein's general theory of relativity there is an effect known as "gravitational redshift," in which light becomes redder because of the influence of gravity; the wavelength of a photon, or light particle, gets longer and appears redder as the wavelength climbs farther away from a

> gravitational well. A gravitational well is the pull of gravity exerted by large bodies in space, like Earth. Under this effect, clocks on Earth's surface actually run slower than clocks far away and experiencing less gravity, so clocks on orbiting satellites run slower. Because of this, redshift has to be factored into calculating positions on Earth with GPS.
>
> Now, while scientists have found absolute evidence of this effect in our solar system, they have found less evidence farther away because the observations are more difficult to make. But now, in a new study, researchers have spotted gravitational redshift in a two-star system a whopping 29,000 light-years (200,000 trillion miles or 321868800000000 kilometers) away called 4U 1916-053. (Accessed 10.06.2023)

For supermassive galactic black hole centers, there is as huge gravity well that might greatly stretch polar jets moving outward from this supermassive black hole center resulting in an intrinsic-like redshift, unrelated to the quasars distance from us. Mainstream gravity theory, GR, concludes that such a great redshifting effect on light from its source cannot be that great. But this conclusion of GR seems only hypothetical since it would be very difficult for this effect to be directly tested. But possibly a much greater gravitational effect of light could be a perpendicular gravitational force changing its relative position concerning its light source, that stretches an existing light wave out via gravity. When stretching results in a bigger picture, we call it gravitational lensing, but if the stretching results is a strictly linear effect of a longer light wave then the results might be observed as an increased redshift along with a stretching of the image along our line of sight. But for quasars, we can only see the quasar jet rather than the galaxy itself.

3.3.1.2 The second hypothesis relates to velocities of polar jets of supermassive galactic black holes. Starting from the 1970's, the velocities of some supermassive black-hole jets have been measured. Measurements indicated the faster-than-light speeds were occurring concerning observed materials in these jets. After more than a decade, some were claiming observing speeds a little faster, up to five times faster than the speed of light. Theory asserts that the speed of light is constant and that nothing can move faster than light. Critics showed how they believed an optical illusion could be occurring, but a few observing astronomers answered these "optical illusion" contentions with very detailed observation detail that they believed could not be contradicted by optical illusion assertions. After consideration, in time nearly all believed that the optical-illusion answer was correct. Even today, some astronomers still assert that some galactic jets (the observable matter within them) can be measured as moving at faster than light speeds relative to the center of the galaxy, while mainstream theorists still claim they are optical illusions.

https://www.iflscience.com/illusion-makes-colliding-neutron-stars-jet-appear-faster-than-speed-of-light-65738

> A jet of material released by the neutron star collision GW170817 is traveling at 99.97 percent of the speed of light and manages to appear as if it is breaking the laws of physics by traveling seven times faster. The Hubble and Gaia space telescopes saw the jet in the days shortly after the collision, but it has taken five years for the images to be processed and analyzed sufficiently to reveal what is going on. (Accessed 10.06.2023)

3.3.1.3 A third hypothesis for redshifting of both quasars and galaxies: Halton Arp and others also proposed that not only quasars but that some distant galaxies also had redshifts that calculate their distances greater than what they really are, as proposed by Halton Arp in his book “Seeing Red.” (19)

Our proposal is that the redshifting of these entities could relate to the changing path of their light through the zero-point-field, which could produce a variable redshift for some galaxies. For example, as galaxies orbit in a somewhat compact cluster their relative position to other galaxies in the cluster would change every few million years. One way this happens we observe as galactic lensing via gravity. Gravity stretches millions of light-years of exiting light emissions out. But in our proposal these light waves get even more stretched out by field flow because it occurs at a much slower velocity than the speed of light, at the velocity of galaxies in a cluster. Therefore there would be a much longer time for their stretching. Our related research and study is seen in the link below.

https://www.researchgate.net/publication/365488325_Background_Field_Flow_Dynamics_of_the_Zero_Point_Field

3.4.2 Another hypothesis for explaining increased redshifts of quasars and galaxies other than increased distances: This possibility is more of a relative motion and fractal universe cosmology proposal.

The web and void structure of the observable universe astronomers have given the name Cosmic Web. It consists of massive filaments of galaxies separated by giant voids. So why does our universe have these peculiar, web-like structures?

We believe these structures relate to a fractal type universe where we see redshifts quantized with higher frequencies at certain values, and at much greater distances we might be seeing just the sides of a great web structures such as the Great Wall, or the super-cluster of galaxies called the Hercules-Corona Borealis Great Wall, The Sloan Great Wall etc. There are many dozens of such known structures.

https://en.wikipedia.org/wiki/List_of_largest_cosmic_structures

> This is a list of the largest cosmic structures so far discovered. The unit of measurement used is the light-year (distance traveled by light in one Julian year; approximately 9.46 trillion kilometres). This list includes superclusters, galaxy filaments and large quasar groups (LQGs). The structures are listed based on their longest dimension. This list refers only to coupling of matter with defined limits, and not the coupling of matter in general (such as, for example, the cosmic microwave background, which fills the entire universe). All structures in this list are defined as to whether their presiding limits have been identified. (Accessed 10.06.2023)

https://en.wikipedia.org/wiki/Fractal_cosmology

> In physical cosmology, fractal cosmology is a set of minority cosmological theories which state that the distribution of matter in the Universe, or the structure of the universe itself, is a fractal across a wide range of scales (see also: multifractal system). More generally, it relates to the usage or appearance of fractals in the study of the universe and matter. A central issue in this field is the fractal dimension of the universe or of matter distribution within it, when measured at very large or very small scales.
>
> The first attempt to model the distribution of galaxies with a fractal pattern was made by Luciano Pietronero and his team in 1987, and a more detailed view of the universe's large-scale structure emerged over the following decade, as the number of cataloged galaxies grew larger. Pietronero argues that the universe shows a definite fractal aspect over a fairly wide range of scale, with a fractal dimension of about 2. The fractal dimension of a homogeneous 3D object would be 3, and 2 for a homogeneous surface, whilst the fractal dimension for a fractal surface is between 2 and 3.
>
> The universe has been observed to be homogeneous and isotropic (i.e. is smoothly distributed) at very large scales, as is expected in a standard Big Bang or Friedmann-Lemaître-Robertson-Walker cosmology, and in most interpretations of the Lambda-Cold Dark Matter model. The scientific consensus interpretation is that the Sloan Digital Sky Survey (SDSS) suggests that things do indeed smooth out above 100 Megaparsecs. (Accessed 10.06.2023)

> One study of the SDSS data in 2004 found "The power spectrum is not well-characterized by a single power law but unambiguously shows curvature ... thereby driving yet another nail into the coffin of the fractal universe hypothesis and any other models predicting a power-law power spectrum". Another analysis of luminous red galaxies (LRGs) in the SDSS data calculated the fractal dimension of galaxy distribution (on a scales from 70 to 100 Mpc/h) at 3, consistent with homogeneity, but that the fractal dimension is 2 "out to roughly 20 h−1 Mpc". In 2012, Scrimgeour et al. definitively showed that large-scale structure of galaxies was homogeneous beyond a scale around 70 Mpc/h. (Accessed 10.06.2023)

Imagine these circular and sometimes spherical webs of galaxies that internally have great voids providing the web-like structures we observe.

https://en.wikipedia.org/wiki/List_of_voids

> This is a list of voids in astronomy. Voids are particularly galaxy-poor regions of space between filaments, making up the large-scale structure of the universe. Some voids are known as supervoids.
>
> A map of galaxy voids. In the tables, z is the cosmological redshift, c the speed of light, and h the dimensionless Hubble parameter, which has a value of approximately 0.7 (the Hubble constant H0 = h × 100 km s−1 Mpc−1). Mpc stands for megaparsec. The co-ordinates (right ascension and declination) and distance given refer to the approximate center of the region.
> (Accessed 10.06.2023)

Other volumes of space at central points of an apparent web may not appear as voids necessarily, but as volumes of much less galactic density. These volumes we might call galactic web bubbles. As to a much older universe cosmology like the PTC, and a number of fractal universe models of a much older universe many dozens of billions of years in age, these bubble structures would accordingly be expanding outwardly from their centers, which once included large galaxies and galaxy clusters that have burned out and no longer held together by gravity or inward field flow, the remnant matter of which are now drifting outwardly from each other and their mutual center of origin. This outward flow can also be called background field flow of the zero-point-field. As these bubbles expand into each other, the web density of their interactions would create even denser web structures of galaxies and galaxy clusters.

According to the related theory, when looking at such bubble web structures from our perspective, the web foreground would be the part of the web moving toward us, and the background part of the expanding bubble would be moving away from us. Besides the distances from front to back of the bubble, there would also be the added relative motion in both directions. The implication could be quantized redshifts along a single line of sight.

3.4.3 The Pan Theory proposal of background field flow

The accuracy of this proposal is far better than dark matter predictions of spiral galaxy velocities compared to observed velocities. According to the Pan Theory the speed of light is not relative to the center of gravity as in GR, but by the motion of the background field in which the light is traveling. It would be possible then that light within galactic polar jets could have faster than light speeds relative to the galactic center since more than an equal part of the background field itself could be accompanying the matter within the jet. If so, then the light itself could travel within the jet at an additional speed-of-light faster than the field and matter within it.

3.4.3.1 Quasars and background field flow

For example if the speed of the background field and some matter within a quasar jet was eventually able to move at the speed of light, the light propagation within the jet could be moving outward at the speed of light relative to the field within the jet. This could be twice the speed of light relative to the galactic center.

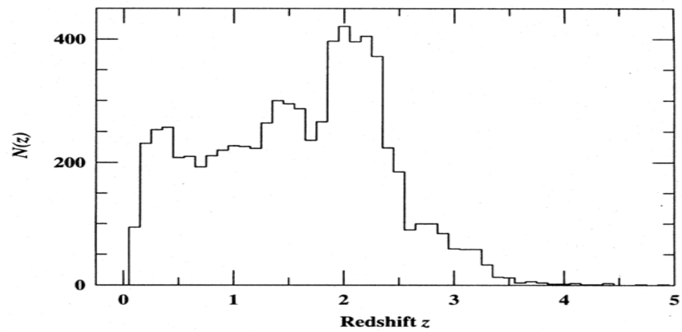
Faster than light, galactic jets

https://en.wikipedia.org/wiki/Superluminal_motion

> In astronomy, superluminal motion is the apparently faster-than-light motion seen in some radio galaxies, BL Lac objects, quasars, blazars and recently also in some galactic sources called microquasars. Bursts of energy moving out along the relativistic jets emitted from these objects can have a proper motion that appears greater than the speed of light. All of these sources are thought to contain a black hole, responsible for the ejection of mass at high velocities. Light echoes can also produce apparent superluminal motion. (Accessed 10.06.2023)

As to faster than light quasar jets, if a faster-than-light jet would move far beyond the gravitational influence of the galaxy and is focused directly toward us (the quasar), its medium would fall out into the local ZPF and its light waves would continue toward us, redshifted (stretched out) much more than its redshifted distance would otherwise indicate, because its waves were stretched in the jet.

Now let's look at a quasar chart below comparing their quantities with their redshifts. In the chart below, the quantity of quasars are indicated on the scale on the left, and below are their redshifted quantities.



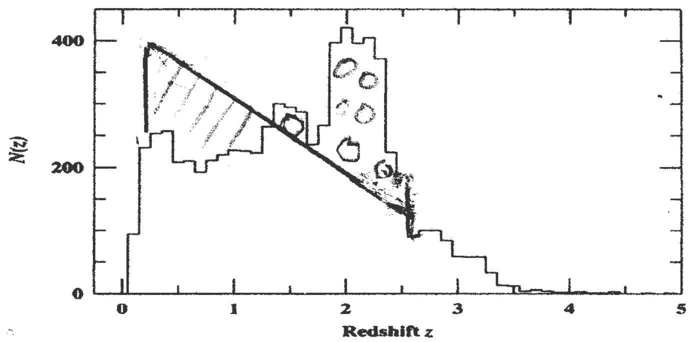
https://ned.ipac.caltech.edu/level5/Cambridge/Cambridge1_3_5.html

> The first few quasars discovered had redshifts that were comparable to those of the most distant known-clusters of galaxies. As more and more quasars were discovered with the refinement of techniques for isolating them (see the next section and Chapter 10), the maximum measured redshifts continued to increase dramatically. By the mid-1970s, several quasars with z gtapprox 3 had been found. The distributions of known quasar redshifts and apparent magnitudes as of 1993 are shown in Figs. 1.7 and 1.8, respectively.
>
> Aside from interest in how these sources produce such copious radiation over a broad spectral range, it was also recognized that quasars provide a possibly unique probe of the early Universe - the light that we are now detecting from the most distant known quasars was emitted by them when the Universe was only a small fraction of its current age, and has been in transit since. Quasars are still the only discrete objects that can be observed with relative ease at z gtapprox 1, and thus they are potentially important cosmological probes. However, in the context of cosmological studies, quasars must be used judiciously. For example, early attempts at producing a Hubble diagram for quasars (as in Fig. 1.9) were not very enlightening because the luminosity function for quasars is very broad, and evolve with time (there are more luminous quasars at high redshift; Chapter 11).
>
> An important early finding was that the number of quasars per unit volume reaches a maximum somewhere around z approx 2, even after correction for the Lyalpha selection effect mentioned in §1.3.4; at earlier epochs (i.e., higher redshifts), they are comparatively rare. Detection of very high-redshift quasars remains of great interest because their existence provides an important constraint on the formation of large structures in the early Universe as well as on the formation of heavy elements, which are clearly seen in the spectra of all quasars. (Accessed 10.06.2023)

This predicts periodic redshift peaks at z = 0.061, 0.30, 0.60, 0.96, 1.50, and 2.1.

As we can see on this chart, the largest quantity of quasars is observed at great distances from us centered around the redshift of about 2. This was the basis for the original BB claim that quasars can only be observed in the distant universe and past; none can be seen close by.

Since then we have seen some quasars much closer. But still the question arises, why do so many quasars congregate at a redshift distance of about 2?



Applying the principles explained above concerning intrinsic redshifting, about 1/3rd of the area of the above chart from a redshift of about .05 to 1.25 that hypothetically existed, shown by diagonals, has been redshifted up to a redshift of about z = 2.25, a redshift from 0 to about 1. This is the chart area where these quasars were shifted to, shown in circles. Therefore the diagonal areas should be equal to the area shown with circles within it. This would be a triangular chart starting from close to z = 05 with a height of about 400, progressively decreasing to a redshift of z =3.75 and a quantity of no more than a dozen quasars – with very few observable quasars beyond that redshift.

This would be a hypothetical quasar distribution chart based upon excessive redshifting due to faster-than-light-speed jets, [(20)] and light traveling at light speed within the jet medium at close to twice the light speed relative the galactic center. It also includes the possibility that quasars that are closer to us are less likely to be focused exactly in our direction so that we would receive the entire jet focus, therefore less likely to meet the definition of a quasar, brightness vs. distance, with a focal-point (stellar) like appearance.

It is also based upon a quasar redshift increase of more than zero up to z = 1, the quasar's real distance redshift plus an addendum redshift up to 1. Although it should be realized that redshift changes are very sensitive to distance. A redshift addendum of only .3 could calculate it to be more than 3 billion light years farther away than it really is; so a very small change in redshifts less than z < 1 can result in a very big over-calculated distance error. Similar problems of distance determination could result from AGN radio galaxies trying to determine their distances. If their jets were focused in our direction some of these AGN radio galaxies would be classified as quasars.

https://www.researchgate.net/publication/353700439_Theory_of_Everything_14#fullTextFileContent

It might be interesting to realize that the two hypotheses above could also be applied to the BB model, Hoyle's SS model and any other model, as well as to the PTC.

PTC: Quasars may have an unfortunate technical definition (21) as far as their general understanding is concerned, distance vs. brightness requirement. The closer a quasar, the less likely its jet might be angled exactly in our direction for us to receive all of its jet's light, and the less likely their definition involving brightness versus distance might be met, cutting down the possibility of close-by quasars via their definition alone. For this reason, and for one or more of the explanations above, a number of closer quasar-like galaxies may be counted as AGN radio galaxies instead.

Quasars defined:

https://en.wikipedia.org/wiki/Quasar

> A quasar (/ˈkweɪzɑːr/ KWAY-zar) is an extremely luminous active galactic nucleus (AGN). It is sometimes known as a quasi-stellar object, abbreviated QSO. The emission from an AGN is powered by a supermassive black hole with a mass ranging from millions to tens of billions of solar masses, surrounded by a gaseous accretion disc. Gas in the disc, falling towards the black hole, heats up because of friction and releases energy in the form of electromagnetic radiation. The radiant energy of quasars is enormous; the most powerful quasars have luminosities thousands of times greater than that of a galaxy such as the Milky Way. Usually, quasars are categorized as a subclass of the more general category of AGN. The redshifts of quasars are of cosmological origin.
>
> The term quasar originated as a contraction of "quasi-stellar [star-like] radio source"—because quasars were first identified during the 1950s as sources of radio-wave emission of unknown physical origin—and when identified in photographic images at visible wavelengths, they re-

sembled faint, star-like points of light. High-resolution images of quasars, particularly from the Hubble Space Telescope, have demonstrated that quasars occur in the centers of galaxies, and that some host galaxies are strongly interacting or merging galaxies. As with other categories of AGN, the observed properties of a quasar depend on many factors, including the mass of the black hole, the rate of gas accretion, the orientation of the accretion disc relative to the observer, the presence or absence of a jet, and the degree of obscuration by gas and dust within the host galaxy.

More than a million quasars have been found, with the nearest known being about 600 million light-years away from Earth. The record for the most distant known quasar continues to change. In 2017, the quasar ULAS J1342+0928 was detected at redshift z = 7.54. Light observed from this 800-million-solar-mass quasar was emitted when the universe was only 690 million years old. In 2020, the quasar Pōniuāʻena was detected from a time only 700 million years after the Big Bang, and with an estimated mass of 1.5 billion times the mass of the Sun. In early 2021, the quasar QSO J0313–1806, with a 1.6-billion-solar-mass black hole, was reported at z = 7.64, 670 million years after the Big Bang.

Quasar discovery surveys have demonstrated that quasar activity was more common in the distant past; the peak epoch was approximately 10 billion years ago. Concentrations of multiple, gravitationally attracted quasars are known as large quasar groups and constitute some of the largest known structures in the universe. (Accessed 10.06.2023)

Now we can look at the graphs above concerning the frequency of quasars relative to their redshifts and calculated distances. We see that the greatest frequency of quasars is at a redshift of about 2. Considering the possibilities of the two hypotheses above and the knowledge that quasars come in different sizes and intensities; some quasars could be brighter, and others more intrinsically redshifted than others. It appears that the primary range of such intrinsic redshifting would be from zero, to roughly 1.0 (their z value addendum). This could put the plurality of redshifts plus their intrinsic values at a "z" value of about 2, and tail off like an almost expected linear distribution like our frequency graph above.

Of course either one, or less-likely both of the two hypotheses above (or even another cause) could result in intrinsic redshifting of quasars, the possibility of which was first made well-known by the famous astronomer Halton Arp, as discussed in some detail above.

3.4.5 Polar Jets of stars and stellar size entities that accordingly could create new matter based upon the PTC.

Also some stellar black holes and neutron stars can be seen to have powerful polar jets at the stellar scale. These jets can also be seen in a few proto-stars with planetary nebula, binary stars, T Taura stars, gamma ray bursters, and cataclysmic variable stars.

Polar Jets from AGN galaxies

https://www.quantamagazine.org/physicists-identify-the-engine-powering-black-hole-energy-beams-20210520/

> Paradoxically, black holes, those infamous swallowers of light and matter, also spew light and matter outward with unparalleled might and efficiency. They power thin beams of plasma called jets that extend thousands of light-years into space, forming glowing line segments seen all across the cosmos. Physicists know why stuff goes in: Black holes have so much gravity that they trap even light, which cloaks them in spheres of invisibility. But why jets shoot out from the edges of many black holes has proved far harder to understand. “One of the biggest mysteries in the universe is how black holes launch jets,” said Sara Issaoun, an astrophysicist at Radboud University in the Netherlands.
>
> Now, through the work of Issaoun and her colleagues on the black hole-observing Event Horizon Telescope (EHT) team, the mystery has started to unravel. Several weeks ago, the EHT released its second photo of a black hole — another view of the same fiery ring pitted by darkness seen in 2019. Both images show the glowing plasma around the supermassive black hole at the center of the galaxy M87, whose giant jet rises outside the frame. Unlike in the first photo, the ring in the new image has stripes, indicating that the light is strongly polarized.
>
> Experts say the spiral pattern of the stripes results from a strong, orderly magnetic field around the M87 black hole, and that this represents the first significant empirical evidence in favor of a popular 44-year-old theory of jet launching, known as the Blandford-Znajek process.
>
> Roger Blandford and Roman Znajek, young physicists at the University of Cambridge in 1977, argued that rotating supermassive black holes will twist ambient magnetic fields into a tight helix, and that this twisting will create a voltage that draws energy up and out of the hole and along the helix. This, they claimed, is the jet — and a big asterisk on the naive notion that nothing escapes black holes. (Accessed 10.06.2023)

3.5 The James Webb Space Telescope observations contradicting BB cosmology, 2023 and beyond

It should be considered that the first James Webb observations at the greatest distances look more like a steady-state universe of some kind, and the furthest galaxies seem to contradict BB cosmology and its predictions concerning how the beginning universe should look. (13) Putting a James Webb background picture alongside a Hubble Deep Field photo, they appear to be almost exactly the same. And both pictures look similar to close-by photos taken inside galaxy clusters, where different apparent ages of galaxies can also be observed.

https://esahubble.org/images/heic1317a/

> This new Hubble image shows galaxy cluster Abell 1689. It combines both visible and infrared data from Hubble's Advanced Camera for Surveys (ACS) with a combined exposure time of over 34 hours (image on left over 13 hours, image on right over 20 hours) to reveal this patch of sky in greater and striking detail than in previous observations.
>
> This image is peppered with glowing golden clumps, bright stars, and distant, ethereal spiral galaxies. Material from some of these galaxies is being stripped away, giving the impression that the galaxy is dripping, or bleeding, into the surrounding space. Also visible are a number of electric blue streak, circling and arcing around the fuzzy galaxies in the center.
>
> These streaks are the telltale signs of a cosmic phenomenon known as gravitational lensing. Abell 1689 is so massive that it bends and warps the space around it, affecting how light from objects behind the cluster travels through space. These streaks are the distorted forms of galaxies that lie behind the cluster.
>
> Since these James Webb discoveries are so new, it will require time for them to be vetted by the peer-review process, and an unapproved pipeline of articles under peer review is growing as the telescope continues to make observations from its first year of planned science. The continuing pipeline of articles will feed into science journals for their consideration, and the merit of these published peer reviewed articles as Future James Webb news will be considered as they submit their peer-reviewed and published findings to the STScI news office for consideration of their promotion.
>
> The PTC correctly predicted what the James Webb has already observed and we believe what it will observe in the future concerning the distant universe. (13) What has been observed in the most distant observable universe seems to be totally contrary to BB cosmology, in our opinion, and we believe in the opinion of many others, with many more anomalies to come, – until the LCDM model and the Big Bang theory as a whole will be replaced in accord with our prediction. (Accessed 10.06.2023)

3.6 A few answers related to, but generally outside the purview of cosmology

APT: How could matter be getting smaller? The answer to this hypothesis is: because all matter goes through an unwinding and rewinding (14) process, which we observe as the particle spin of fermions (spinning atomic particles). This spin is real according to the Pan Theory but is now called the material characteristic of angular momentum instead. What is time? Time is simply defined as an interval of change, the rate of change measured by a clock, no more than this. Why does the rate of time change for accelerating particles and particles under the influence of gravity? These particles are either accelerating against the bacground field of motion (the ZPF), or moving against this accelerating field concerning gravity. They are the same relatively speaking and the resistance of the acceleration changes the rate a particle unwinds and rewinds and our measurement of time vis-à-vis clocks. The reason for angular momentum, on the other hand, has no acknowledged explanation in particle physics.

APT: What is space? Space is the distance between matter and the volume that encompasses both matter and field (the ZPF). If the universe in not infinite then where did it come from and what's beyond it? There was no time or space before the first change of the beginning entity, which is called a pan in the Pan Theory. The first changes within it defined the meanings of both time and space. Based upon the definition of space directly above, space has no meaning or existence beyond the confines of matter and field. For this, the word "nothing" would have no existence in reality. What is gravity? Gravity would be the pushing force of the background field upon matter. It not only creates the condition of matter by definition, but pushes it together like a surrounding atmosphere. What is a field? Although a field can be described in many ways including mathematically, it can be something physical APT that through its action can create energy.

4. Conclusions

We have concluded that the Lambda Cold Dark Matter model is wrong, which would include nearly all of its foundation pillars, dark matter, dark energy, and probably both the expansion of space and an evolving universe. Instead the most distant universe observations are pointing to a universe very similar or the same as the local universe. If so, almost any steady-state theory could have made better predictions concerning the most distant universe than the ΛCDM does. Although Einstein and many others have proposed a steady state universe [22] over the many years, very few of these theories are remembered today

The general conclusion and prediction of this analysis is that the ΛCDM will eventually be replaced by a much-less contradicted cosmology within the remaining decade, if not sooner. In the meantime it might be expected that one or more theorists might propose changes to mainstream cosmology that would allow for a much older universe, the limiting ingredient primarily being the Hubble distance formula.

4.1 Conclusion: For those Looking to find a better cosmology

To consider a new cosmology, look at the latest from the James Webb. It presently seems that new discoveries will be coming from this infrared telescope on an ongoing basis, but also look for other new scopes and array observation discoveries. Whatever theory changes are being considered, be sure they are consistent with James Webb observations. If one is considering an evolving universe model, find a good rationale as to why the James Webb and other galactic photos of all eras of the universe seem to look the same, unless one believes otherwise.

For SS models, calculated distances would be more proportional to redshifts with no distance limit to it. We believe that any alternative cosmology that is consistent with JWST observations will be a steady-state-like model of some kind since the JWST most distant observations seem to look the same as Hubble Deep Field photos, and the same as photos looking within local galaxy clusters.

There are many alternative cosmologies to choose from which have already been proposed, plus almost countless lesser-known possibilities, which might be consistent with the JWST photos. We believe almost any cosmology that proposes a much older universe and does not use the Hubble distance formula might work. A few of these proposed alternatives can be seen in the two links below, but there have been almost countess other proposed possibilities, most of which are little known.

https://en.wikipedia.org/wiki/Non-standard_cosmology

> A non-standard cosmology is any physical cosmological model of the universe that was, or still is, proposed as an alternative to the then-current standard model of cosmology. The term non-standard is applied to any theory that does not conform to the scientific consensus. Because the term depends on the prevailing consensus, the meaning of the term changes over time. For example, hot dark matter would not have been considered non-standard in 1990, but would be in 2010. Conversely, a non-zero cosmological constant resulting in an accelerating universe would have been considered non-standard in 1990, but is part of the standard cosmology in 2010.
>
> Several major cosmological disputes have occurred throughout the history of cosmology. One of the earliest was the Copernican Revolution, which established the heliocentric model of the Solar System. More recent was the Great Debate of 1920, in the aftermath of which the Milky Way's status as but one of the Universe's many galaxies was established. From the 1940s to the 1960s, the astrophysical community was equally divided between supporters of the Big Bang theory and supporters of a rival steady state universe; this is currently decided in favour of the Big Bang theory by advances in observational cosmology in the late 1960s. Nevertheless, there remained vocal detractors of the Big Bang theory including Fred Hoyle, Jayant Narlikar, Halton Arp, and Hannes Alfvén, whose cosmologies were relegated to the fringes of astronomical research. The few Big Bang opponents still active today often ignore well-established evidence from newer research, and as a consequence, today non-standard cosmologies that reject the Big Bang entirely are rarely published in peer-reviewed science journals but appear online in marginal journals and private websites.
>
> The current standard model of cosmology is the Lambda-CDM model, wherein the Universe is governed by general relativity, began with a Big Bang and today is a nearly-flat universe that consists of approximately 5% baryons, 27% cold dark matter, and 68% dark energy. Lambda-CDM has been a successful model, but recent observational evidence seem to indicate significant tensions in Lambda-CDM, such as the Hubble tension, the KBC void, the dwarf galaxy problem, et cetera. Research on extensions or modifications to Lambda-CDM, as well as fundamentally different models, is ongoing. Topics investigated include quintessence, Modified Newtonian Dynamics (MOND) and its relativistic generalization TeVeS, and warm dark matter.
> (Accessed 10.06.2023)

https://rationalwiki.org/wiki/Alternative_cosmology

> Alternative cosmology can include any physical science-based cosmological model of the Universe proposed as an alternative to the standard Big Bang model. Apart from the Steady State theory, most of them deny that space or the universe is expanding. It should be remembered that "alternative medicine" which actually works is called "medicine". The same care needs to be taken with "alternative cosmology".

For The Pan Theory of Cosmology to be considered for the cosmology replacement process, its explanations and equations that make almost perfect predictions should become more well known, eliminating the need for Dark Matter. The approach we will follow will be to educate as many astronomers that are interested, as to the far-greater accuracy of the Zero-Point-Field flow model over the great inaccuracies of the dark matter proposal in predicting stellar velocities in spiral galaxies, and also explain the better predictions within galaxy clusters. Secondly we plan to discuss our distance and brightness equations and how they fit type 1a supernovae far better than does the Hubble distance formula, eliminating the need for hypothesized Dark Energy.

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Σ Π

Background Field Flow Dynamics

Exact calculations of spiral galaxy rotations
Based upon observed galactic matter and
Newly proposed background field vortex flow forces [*]

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Abstract: Based on a preconceived hypothesis, the goal of our research was to propose a model that would predict spiral galaxy velocities with the highest possible accuracy. We believe we have achieved this goal with unparalleled precision. Additionally, another objective was to explain the increased velocities observed in galaxy clusters and velocity anomalies within the observable universe using the same proposed mechanism.

Our research highlights a significant issue with the dark matter hypothesis: its inadequate predictions concerning spiral galaxies compared to various proposed alternatives. Furthermore, our study indicates that dark matter also faces substantial challenges in making verifiable predictions about galaxy clusters, as corroborated by other researchers. Similarly, modified-gravity models encounter their own difficulties regarding predictions of galaxy-cluster velocities.

Our model, like the dark matter hypothesis, proposes the existence of a physically flowing background field. However, unlike dark matter, this background field comprises non-matter particulates, and the fields accelerating vortex motion would enhance stellar velocities, making gravitational influences negligible. We posit that at the scale of galaxy clusters, this background field-flow explanation has been supported by observational data and statistical correlation studies conducted by other researchers. The observed correlations were between the directional flow of the clusters and the rotation directions and axes of rotation of the galaxies within them. These correlations appear to contradict the increased gravitational influences proposed by dark matter or any other gravitational mechanisms.

Moreover, our findings suggest that the proposed background field-flow model not only aligns with observed data but also provides a more coherent explanation for various velocity anomalies observed in the universe. The implications of our model extend beyond just predicting spiral galaxy velocities; they offer a new perspective on understanding the dynamics of galaxy clusters and the universe at large. Future research should further explore the properties and behaviors of this background field to solidify its role in cosmic dynamics and to address any remaining anomalies that current models cannot explain.

In conclusion, our research presents a compelling alternative to dark matter and modified-gravity models, proposing a novel mechanism that more accurately predicts observed phenomena in the universe. We believe this model holds the potential to revolutionize our understanding of galactic dynamics and offers a robust framework for future investigations in cosmology.

Keywords: Astronomy, Cosmology, spiral galaxies, rotation profiles

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[*] *This is the much longer preprint version of the recently (2022) abbreviated journal published version "Simple but Exact Calculations of Spiral Galaxy Velocities …"*
https://ej-physics.org/index.php/ejphysics/article/view/167/132
This longer version contains all the equations and calculations necessary to better understand and calculate spiral galaxy velocity profiles without dark matter or modified gravity.

1. Introduction, General Purpose and goal of this paper

This proposal may be difficult for some readers and astronomers alike to quickly understand without sometimes rereading sections with deliberation since it proposes new concepts, which are foreign to mainstream astronomy and cosmology. As our research progressed, our general goal was to make the best possible spiral galaxy velocity predictions possible. This we accomplished with newly formulated Newton style non-gravity equations, proposing an alternative model that could explain observation anomalies at all scales of the universe. We believe this paper is proof of the success of that goal concerning spiral galaxies. This model is an alternative to dark matter, to modified gravity proposals, or to any model proposing to explain gravitational anomalies now primarily attributed to the existence of dark matter.

When we refer to field-flow(s) in this study, we are referring to a non-observable background field believed to be a physical non-matter field expectedly the Zero Point Field (ZPE, ZPF. To test this field-flow hypothesis for spiral galaxies, the essence of this study, we acquired what we determined to be very accurate observation data and Newtonian velocity profile data based upon our own analysis. The exactness of our predictions is also a testament to the accuracy of this acquired data. We derived unique non-gravity equations for our calculations based upon our background-field-flow model and Newtonian mass/velocity equations.

These equations are not gravity-changing equations but instead calculate a proposed physical background-field directed pushing forces separate from gravity. As a proposed vortex within spiral galaxies, these forces would increase orbital velocities of matter while maintaining their radial positions by an inward-pushing vortex vector. The addendum forces and resultant energy being proposed, is not believed to be a primary force of nature but instead a more mundane contact pushing force of a background quantum field based upon its relative velocity.

What is a background field according to our use of it in this proposal? In quantum physics there have been many background fields proposed, but the background field that was first proposed to exist over a hundred years ago is called the Zero Point Field (ZPE or ZPF). For more than 50 years, observations of this field assert that it is made up of very short-lived particles of matter, which have been called virtual particles.

A more recent background field proposal is the Higgs field. The reality of such background fields is known collectively as the quantum substrate. Such hypothetical fields that have also been proposed include dark matter, dark energy, and more speculative fields such as gravitons, quantum foam, etc.

The characteristics of the background field we are proposing are based upon the collective name of it. This "*moving background field, sometimes called the quantum substrate (QS)), represents locally the ultimate reference (frame) for rest and for the motion of matter and fields. This is accomplished automatically if the QS is the substrate in, which all the elementary particles and fields are excited and in, which they propagate according to the rules dictated by quantum mechanics or move classically according to the principle of inertia* [1]."

1.1 The unique equations of the FFV model.

Along with explaining the derivation of these unique equations, we have provided the related hypothetical justifications concerning how and why spiral galaxies form and function the way we observe them, concerning their form, orbital velocities, and the rationale for their creation and sustained existence.

As evidence for the validity of these derived equations, the resultant calculations plus the effects of Newtonian gravity when combined with the calculated background substrate velocities, almost always perfectly match the observed velocity profiles of spiral galaxies in every case, with an error range no more than that of the input data. Statistical analysis shows an almost perfect correlation between the observable matter of a spiral galaxy and the observed velocities (rotation profile) of its disc stars. The implications of these predictions and related rationale also can explain the motions of galaxies in groups and clusters, observed galactic lensing angles, as well as being able to explain anomalous motions concerning the observable universe as a whole.

Additionally in our research, we found observational evidence, and the statistical analysis by others in line with our field flow proposal and our expectations concerning the widest-ranging field flows at the largest scales of the observable universe, as will be shown in the text.

2. General Discussion

2.1 The Field Flow and Vortex model (FFV)

The result of this research and study was the background Field-Flow and Vortex model (FFV), which is the primary subject and proposal of this paper. The model is proposed primarily as an alternative to dark matter, but also to alternative-gravity models. The model proposes a flowing background non-matter field, which is used to explain and calculate the rotation velocities of spiral galaxy disc stars and other observation anomalies contrary to the dark matter hypothesis and modified gravity models.

Such background fields have been known to exist for many decades now such as the Zero Point Field (ZPF and ZPE) of quantum mechanics, the newly asserted Higgs Field, and theorized fields such as dark matter, dark energy, gravitons, etc. None of these fields however have been proposed as being the source of the observed excess velocities of spiral galaxies by way of the pushing forces of their kinetic flows; this is what we are proposing. The proof of this model is in the exactness of its velocity profile predictions resulting in *almost exact statistical correlations with observed velocity profiles of* dozens of randomly chosen spiral galaxies.

2.2 The present model of the universe, dark matter and related problems

For those who are very familiar with the many problems, discrepancies, and inaccuracies of the dark matter hypothesis and modeling, and/or those wishing to read ahead to our FFV proposal first, can skip down to section 2.5 and return back here to section 2.2 for additional information concerning, what we believe to be “insurmountable” problems with dark matter theory. For those readers wishing more information concerning the many more problems with dark matter theory including its experimental non-detection, we can send you, upon request, the many additional pages we have deleted here to condense the paper’s length.

Dark matter, dark energy, and the Inflation hypotheses are now foundation hypothesis within modern cosmology, the Concordance Lambda Cold Dark Matter model. The problem, however, is that all of these hypotheses are presently unknowns as to their nature, causes, etc. All are ad hoc hypothesis that a growing number believe are un-testable and therefore not science but placeholders for the real causes of the observation-anomalies they are supposed to explain.

Hypothetical dark matter is believed by most to have the same gravitational effects as ordinary matter except for its proposed quantities, requiring more than five times as much dark matter as ordinary matter. Based upon accepted gravitation theory, if dark matter were generally distributed in a somewhat even mix with ordinary matter, observed velocity profiles of spiral galaxies would generally look similar to Newtonian velocity profiles except that velocities would be much greater because of the great increase in matter required. There would be few if any flat rotation curves such as those observed in many spiral galaxies like the Milky Way.

For this reason the most important necessary characteristic of dark matter concerning spiral galaxy predictions would be its gravitational influences outside the galaxy. This has been called the galaxy’s dark matter spherical halo. If hypothetical dark matter could, for some reason mostly exist outside of spiral galaxies with little influence inside them, then dark matter predictions could be better, but then what newly proposed characteristics of dark matter and their proposed halos would be needed?

Seemingly contrary to the existence of dark matter halos, stellar clusters and small galaxies often orbit relatively close to larger galaxies. Wouldn't they be gravitationally affected by large diameter Halos of dark matter?

Both the Milky Way and Andromeda Galaxies have a number of adjacent stellar clusters and small galaxies orbiting in a single plane somewhat perpendicular to the galaxy's spiral disc, called the Magellanic and the Andromeda Polar Planes respectively. The existence of such somewhat perpendicular planes may also be true for many other large spiral galaxies but most such structures are just too far away to observe such relatively small, adjacent stellar clusters and galaxies. Neither increased gravity nor dark matter theory can explain these perpendicular galactic planes and related observations as described by Pawlowski et al [2]. The FFV model, on the other hand, can easily explain such rotating perpendicular planes, by opposing background-field vortices pushing smaller galaxies and stellar clusters together into a single plane, similar to the formation process of the single disc plane of a spiral galaxy in the first place, according to the FFV model.

In a paper published in 2018, an international team of four researchers believes they have observed the same orbiting disk formation of dwarf galaxies orbiting the elliptical galaxy Centaurus A, which is relatively close, about 30 million light-years away from the Milky Way. This paper points out "Dwarf galaxies should travel randomly around their parent, based on the standard model of how galaxies form according to accepted gravitation theory. Seeing yet another galaxy with this strange (orbiting disc) behavior is highly unlikely, and calls into question the very model that scientists use to understand the structure in our universe," according to Müller, the lead author of the paper [12].

Müller also said that "perhaps the further study of the additional dwarf satellites of this galaxy may not be consistent with their initial findings, perhaps our team has found just another statistical outlier concerning large galaxies in general, perhaps isolated galaxies work differently from galaxies much closer together in large groups, or perhaps many more such galaxies with orbital discs of smaller galaxies orbiting in plains other than the galactic plane will also be discovered in time or when observation technology improves"[3].

There have been a number of different types of dark matter proposals, but if the distribution of dark matter proposed is different from the known distribution of ordinary matter within the galaxy then theoretical problems arise. Dark matter models that do not adhere to this principle have both logical and observational problems such as not finding adequate influences of dark matter in the galactic core, not finding dark matter influences in our solar system, etc. Such problems of logic have been called the "Cusp-Core problem," and the related "Cuspy Halo Problem" [4], as well as other dark matter theoretical problems that so far have not been satisfactorily explained by either observation or logic.

2.3 Modified gravity models

The most well known alternatives to dark matter are called modified gravity models. All such models propose alternative formulations for gravity-based upon increased gravitational strength at large intra-galactic distances. Mordehai Milgrom proposed the best known of these models, which were called the Modified Newtonian Dynamics, MOND. Based upon our research and that of others, nearly all modified gravity models make much better predictions of spiral galaxy rotation profiles than do dark matter models. According to our research, one of the most accurate of these modified-gravity models is called Metric Skew Tensor Gravity (MSTG) proposed by Brownstein and Moffat [5].

We obtained much of our raw data and related graphs from their research and publications. But like dark matter models these proposals also have major problems associated with them: 1) Most practitioners believe that modified gravity models in general, lack a justifiable rationale as to why the force of gravity should increase in the outer parts of spiral galaxies to justify their equations, and 2) These models also do not seem to be able to explain the higher rotation velocities observed in galaxy groups and clusters, or the extent of the bending (lensing) of galactic light, without also resorting to proposals of unseen matter. For these models, such matter is asserted by their proponents to be a yet unidentified form of known matter of some kind. On the other hand we believe related observations by others concerning increased velocity observations within galaxy clusters and other observation anomalies now primarily attributed to dark matter, can be "easily explained" by background-field flow better than any other model for reasons we will discuss.

2.4 Observations otherwise explained or contrary to dark matter

Maybe the most well known observations concerning the implied evidence for dark matter concerns Abell 520, and the Bullet Cluster. Abell 520 appears to be a collision between three galaxy **clusters**, and the Bullet Cluster a collision between two galaxy clusters. On the periphery of these collisions the excess bending of light is observed as if these peripheral volumes contained a great deal of non-luminous matter, many believe to be dark matter.

The Bullet Cluster, 1E 0657-56 in Carina, is believed to represent the collision of two galaxy clusters and their accompanying, extremely hot interstellar gases, is generally considered to be the best observational evidence for dark matter [2]. These observations are based upon gravitational lensing seen outside of the visible galaxy clusters and adjacent to extremely hot intergalactic gases. Since the lensing is separated from the visible mass of the cluster, and because lensing is believed to be associated with strong gravitational influences, the mainstream conclusion has been that dark matter has separated from the two clusters and is the source of the observed lensing.

An alternative explanation for both observations is that this lensing is mostly due to electromagnetic radiation refraction by the variable refraction index of observed extremely hot galactic gases that the radiation passes through when leaving these clusters, and/or by Fresnel dragging by high velocity plasma in the clusters. Based upon the observed and estimated mass of these clusters alone, these causes could explain the observed extent of lensing without the existence of dark matter [10]. According to the FFV model the extent of this refraction can also be explained by field flow, but the extent of refraction by hot gasses and/ or Fresnel dragging is the better answer based upon Occam's razor since no unknown is required for this explanation.

Abell 520 is a very large merger of galaxy clusters located 2.4 billion light-years away based on redshift analysis. Astronomers using the Hubble Space Telescope have observed what they believe to be a clumping of dark matter left behind from cluster collisions, which "challenges current theories about dark matter that predict galaxies should be anchored to the invisible substance even during the shock of a collision" (NASA. 03/02/12,Dark Matter Core Defies Explanation, Hubble Space Telescope). This is a similar finding concerning the Bullet Cluster, where lensing appears directly adjacent to hot intergalactic gases, and where a dark matter core is also supposed to exist. As in the above, the observed lensing angles accordingly could easily be explained by light refraction by hot intergalactic gases, the density differences and flows of adjacent galactic clouds and galactic winds, and/or by vortex currents resulting from galaxy and cluster vortex interactions according to the FFV model.

There is currently no satisfactory explanation, in the authors' opinion, that in cluster collisions that dark matter should aggregate on the outskirts of galaxies. If it is gravitationally responsive it should aggregate generally in accord with the inverse square law of gravity. Although there may be dark matter models to the contrary, many astronomers would likely consider that clusters should retain its dark matter the same as ordinary matter upon their collisions with other clusters.

Based upon our research, when dark matter is used to model rotation profiles of spiral galaxies, dark matter modeling does not closely match observations; instead the results are a much smoother velocity profile, with a much larger transition radius from the core than what is actually observed. This dark-matter quandary also relates to finding little evidence for dark matter in the Milky Way core and in our neighborhood, which appears to be the case for all spiral galaxies according to our analyses of their velocity profiles.

Another big theoretical problem with dark matter, which continues as an open question, is how the brightness of galaxies affects their rotation velocities. This relationship is known as the Tully-Fisher relation and it has shown countless times that a galaxy's visible mass and brightness directly correlates with its rotational velocity, contrary to dark matter. But the primary quantitative and predictive evidence against dark matter is that in most cases spiral galaxy rotation profiles cannot be predicted by dark matter, as shown and explained within this paper. This can be understood by the total lack of published studies of dark matter velocity profiles, studies containing many spiral galaxies of varying sizes and distances from us.

To explain this lack of predictability it is often asserted that the distribution of dark matter need not be consistent with the distribution of observable matter. But if so, why shouldn't dark matter respond to, and produce gravitational effects the same as ordinary model?

In contrast to the general lack of published results and accuracy concerning dark matter predictions of spiral galaxies, alternative models, their predictions, explanations, and comments have been published in a great number of papers, some of, which are briefly explained below:

Citing such observations in a related paper, astronomer Stacy Mc Gough of Case Western Reserve University, a longtime critic of the dark matter and a proponent of MOND, summed up his opinions concerning dark matter and the Lambda-CDM model in general when he said**:**

"At this point, there is a mountain of such contradictory details that we've mostly swept under the proverbial rug. Dark matter and dark energy have been around so long that people forget that we backed into them. They're tooth fairies that we invoked early on to make things work out. And if no one finds evidence of dark matter then the paradigm collapses like a house of cards"[10].

A required characteristic of a valid hypothesis or theory is one that is falsifiable [11]. The concept of dark matter is probably not falsifiable, but a number of other major hypotheses within mainstream cosmology are also not falsifiable. "All the evidence we have for the existence of dark matter is indirect, which (the hypothesis) won't go away even if laboratory experiments never find dark matter particles. Physicists accept the concept of dark matter because (they believe) it works"[10] – evidence to the contrary is little known or published.

Although dark matter has made some accurate predictions, our research indicates that over-all the hypothesis does not work well since often it also makes inaccurate predictions, as well as predictions, which have been proven wrong by observation, as explained in this paper.

Some of those who have studied dark matter and are well aware of its problems also have questioned its existence. Arthur Kosowsky, professor of physics and astronomy at the University of Pittsburgh, upon reviewing research and statistical calculations concerning spiral galaxy rotation profiles conducted by Case Western University stated:.. … "If there is a single observation, which keeps me awake at night worrying that we might have something essentially wrong, this is it" (referring to the lack of dark matter in the following study):

In a 2016 study by Case Western University, a team of astronomers found a striking correlation between the visible matter of spiral galaxies and their rotation velocities. This means "*they can (generally) predict the rotation of galaxies without invoking the existence of dark matter. According to the standard model of cosmology, the immense gravity of dark matter is crucial for explaining why galaxies can spin so fast without tearing themselves apart. The discovery may alter the understanding of dark matter and the internal dynamics of galaxies*"[10].

2.4.1 Observations contrary to the dark matter paradigm

We will begin with the most recent dark matter contradictions that have been observed within galaxy clusters. Published September 2020 in the journal "Science"[13]:

Using the Hubble Space Telescope and the European Southern Observatory's Very Large Telescope in Chile, astronomers observed distortions of light from gravitational lensing by studying 11 separate massive galaxy clusters. These details showed small, distorted images of distant galaxies within larger gravitational lensing distortions near the cores of each galaxy cluster. These small distortions looked like arcs and smears in these photographic images.

The observations themselves surprised astronomers because they differed from their theoretical models concerning the expected distribution of dark matter and the predicted influences of their supposed large halos within galaxy clusters. But since they believed densely concentrated pockets of dark matter in these galaxy clusters could create these aberrations, they performed simulations to confirm or deny this possibility.

A quote from their paper states: "Galaxy clusters are ideal laboratories to understand if computer simulations of the universe reliably reproduce what we can infer about dark matter and its interplay with the luminous matter," said Massimo Meneghetti, lead study author and adjunct professor at the National Institute for Astrophysics -- Observatory of Astrophysics and Space Science of Bologna in Italy.

Upon completion of their simulations and calculations, they realized the failure of their simulations to correctly model the galaxy clusters' light aberrations based upon dark matter. Thereafter Meneghetti stated:

"We have done a lot of careful testing in comparing the simulations and data in this study, and our finding of the mismatch persists (between theory and observations). One possible origin for this discrepancy is that we may be missing some key physics in the simulations."

Hubble enabled the researchers to map out their proposed amounts and locations of dark matter within the clusters studied, trying to match dark matter theory with observations. The data also allowed them to estimate the mass of each galaxy including its theorized dark matter content.

When these observation maps were compared with the simulated galaxy clusters of the same distances and galaxy locations within the cluster, the amount of dark matter needed and its locations based upon gravity theory, didn't match at all with the observed details of the individual galaxies within the cluster.

An astronomer and senior theorist on the research team stated: "There's a feature of the real universe that we are simply not capturing in our current theoretical models," said Priyamvada Natarajan of Yale University.

Their paper generally concluded that there are unidentified problems with prevailing simulation methods or theory to enable accurate galaxy cluster modeling based upon dark matter. Natarajan also said: "The observationally constrained lens models reproduce the shapes and sizes of the observed GGSL (gravitationally lensed) events. For instance, the model predicted image positions match within ◎0.5 arc sec with what is seen (observable matter). The discrepancy between observations and (dark matter) simulations may be due to issues with either the cold dark matter paradigm or simulation methods [13]”. This statement generally says that the observable matter of the clusters was a far better match to what was observed than was dark matter modeling.

2.5 Little known alternatives to dark matter and modified gravity

There have been many proposed alternatives to dark matter other than modified gravity models. Some of these models propose a new fundamental force of nature to explain spiral galaxy velocity profiles. Such ideas have collectively been called “fifth force" proposals [6]. They propose another fundamental force of nature beyond gravity to explain gravitational anomalies such as the excess velocities observed in spiral galaxy rotation profiles. Although the FFV model is not one of these models, its calculation results using the FFV equations could be used for such a model, or even for a modified gravity model or other alternatives with different justifications for their use.

Other models have proposed electromagnetic influences to explain increased velocities within spiral galaxies [7]. Another alternative proposes that spiral galaxy rotation profiles can be explained by General relativity and Quantum cosmology in the absence of dark matter, using combined equations of both [8]. Another proposal asserts that the mechanics of the calculations themselves are the problem for determining the correct spiral galaxy rotation profiles rather than the amount of matter in the galaxy, its distribution, or the formulation of Newtonian gravity. Still another group of proposals are called Emergent or Conformal gravity [9]. These models propose that space-time is made up of small elements whose collective motions produce the force of gravity. Modified gravity and Emergent gravity models are the most well known mainstream models arguing against dark matter. Criticisms of most of these proposals generally involve their perceived inability to address other aspects of what dark matter proposes to explain such as velocities of galaxies in a cluster, the extent of gravitational lensing, the additional motions and supposed gravitational influences concerning the universe as a whole, without also having to propose “unrealistic” quantities of unseen matter of some kind, like dark matter models require.

Many sources have made this statement: If we cannot find dark matter we should then look for dark forces. We believe we have discovered such forces, which are the basis of the FFV model. This model proposes these mundane pushing forces of background-field-flows (a quantum substrate, that when calculated and added to the forces of gravity, make "undeniably" exact predictions.

2.6 The FFV model and the field flows being proposed

The key to realizing the validity of the FFV model is the realization of its almost perfect predictions, which can be understood better by understanding the related correlation statistics and by performing the calculations, which yield exact results. But to understand the logical basis of the model and of these exact calculations one should understand the mechanics of the proposed aetherial background-field flow as explained below.

These calculations are based upon velocity profile data of spiral galaxies including their observed velocity profiles and calculated Newtonian velocity profiles**.**

Brownstein and Maffat 2005 (8) concerning spiral galaxies obtained all of our data for calculations in this study from publications. From this data we have calculated our proposed aetherial vortex velocity profiles of the many galaxies for, which they have published Newtonian and observed velocity profiles. We believe the exactness of our calculated predictions is also a testament to the great accuracy of their velocity profile data.

In accord with the FFV model, the strength of the aetherial-like vortex within spiral galaxies would depend upon a number of different factors. Younger, larger, brighter, bluer, and denser galaxies would tend to have stronger and faster background field vortices within them. Older, smaller, dimmer, redder, and more spread out galaxies would tend to have less or little apparent background field flows within them. A galaxy's relative position within a cluster would also be a factor. Those galaxies closer to large galaxies would likely have unpredictable background field flows. Some of these field flow vortices would be stronger and some weaker than similar, more separated galaxies.

Generally, cores of most spiral galaxies rotate similar to a rigid-body vortex up to their peak velocities but these velocities can generally be more accurately calculated based upon their observed core matter. Outside the core and into the galactic disc, according to the FFV model, vortex velocities would progressively increase in proportion to increasing radial distances. Such proposed background field-flow velocities would average those of stellar velocities within spiral galaxies. Field flows external to galaxies would generally be much greater and would average those of galactic velocities within clusters. Within the large-scale flows of clusters and super clusters, there would also be background field flows between galaxy groups and clusters.

Aetherial background field flows in general could relate to background field pressure differences inside and outside of galaxies. At the largest scales, field flows would first relate to the overall directional flow of the cluster itself as to its proper motion, and then to the individual field flows between individual galaxies. *But the bottom line is that all of these proposed influences as to spiral galaxies could be easily calculated as a whole by the FFV model based upon observed spiral-galaxy disc velocities, without their individual considerations.*

2.6.1 Field Flows within galaxy clusters

According to the FFV model, the average stellar velocities within spiral galaxies, as well as the average galactic velocities within clusters, would roughly average twice as fast as velocities calculated solely based upon conventional gravity.

A study recently published in The Astrophysical Journal, October 2019, found hundreds of galaxies rotating in sync with each other, galaxies tens of millions of light-years away from each other in the same cluster.

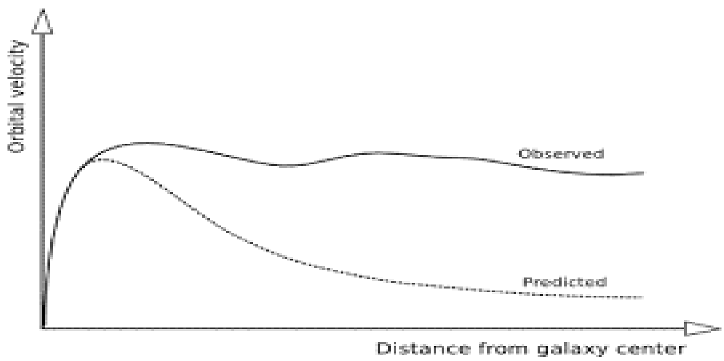
According to a quote from the lead author of this paper concerning the statistical coherence between the rotation directions and orbital planes of galaxies within the cluster: “The observed coherence must have some relationship with large-scale structures because it is impossible that the galaxies separated by six mega-parsecs [roughly 20 million light-years away from each other] directly interact with each other," according to lead author Joon Hyeop Lee the lead astronomer and author of the study at the Korea Astronomy and Space Science Institute.[14]

Since background-field-flow (the quantum substrate) can easily explain what they have observed, we believe this and similar observations, along with the almost certain accuracy of spiral galaxy predictions, provide the strongest possible evidence for the validity of the FFV model.

2.7 The mechanics of spiral galaxies according to the FFV model

We will begin with a generic spiral galaxy rotation curve, typical of most large galaxies including the Milky Way. As one can see by figure 1, this is very similar to the proposed form of the Milky Way, figure 2 below. The top line shows the observed velocity profile. The bottom line shows the Newtonian predicted velocity profile. The horizontal measurement line shows distances expressed in kiloparsecs, and the side vertical line usually shows the velocities of stars in kilometers per second.

Figure 1

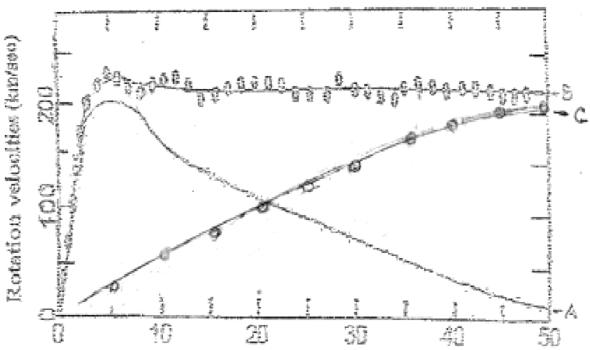


Velocity profile of a typical large spiral galaxy like the Milky Way [15]

3 Equations, calculations, and testing the FFV model

The following equations have been used to calculate all the spiral galaxy rotation profiles in this study. Of the eight equations presented in this paper, equations (1) & (4) through (8) are unique to the FFV model and were derived based upon the model and its assertions.

The observed, calculated, and predicted velocity profiles Figure 2



The Milky Way galaxy: Distances in kiloparsecs (kpc)

Composite graph: The observation velocity profile of the Milky Way, figure 2 line B, was taken from an Ohio State website [16]; the Newtonian profile was taken from a University of Michigan website (15). No credit was mentioned for their astronomy authors. We made this composite because we found no single data source that showed consistency between these two velocity profiles and figure 1 above, which we believe exemplifies in form, a standard model of spiral galaxy velocity profiles like the Milky Way.

Below is the first and simplest of the FFV model equations, Equation (1). Its calculation results are shown in figure 2, line C, concerning the Milky Way. This equation is based upon the simple difference between the Newtonian and the Observed velocity profiles at the same radii, shown as lines A and B respectively. Line B is the observed velocity profile and line A is the calculated Newtonian velocity profile. Line C is the calculated and proposed vortex velocity profile of Equation (1). Velocity B minus velocity A equals C. This will always be true for all spiral galaxies since line A plus line B will always equal line C, simply a matter of definition. Later line C, our proposed vortex velocity profile, will be calculated by another means, equations based upon the observable galactic matter and its distribution. This is the crux of this proposal: that the calculated results of both equations match each other.

And if so the results could indisputably predict spiral galaxy velocity profiles within the error range of the input data. It might be noted that the visible Milky Way only extends to about 20 kiloparsecs radius. Radio telescopes have extended the observation information to 50 kiloparsecs.

$$\mathbf{Vv} = \mathbf{Ov} - \mathbf{Nv} \tag{1}$$

We call this the Primary Difference Equation, where $\mathbf{Vv}$ calculates line C of figure 4 above, which is the proposed vortex velocity at any given radial distance. The observationally determined average velocity $\mathbf{Ov}$ at a chosen bin location, and $\mathbf{Nv}$ represents the average Newtonian velocity at that same radial distance. Line C, as the difference between the two, includes the velocities from both the Newtonian and observed velocity profiles needed by this equation. Of course, this is obvious since line C minus line A will always equal line B because A plus C will always equal line B as defined and explained above.

Equation (1) is not a necessary equation of the FFV proposal but it is very convenient for use in understanding and calculates the predictions of the FFV model. It is more convenient to analyze, easier to graph, and an easier way to understand the accuracy of the FFV model instead of comparing the observed velocity profile with direct graphical predictions of it, which we will further explain and demonstrate.

Of course, this $\mathbf{Vv}$ calculation is meaningless and evidence for nothing by itself, but it will be used in this study as the basis for statistical calculations and comparison with the results of the second relatively simple equation, which also calculates line C. This is done to determine the accuracy of the vortex model and its calculations. This equation is based solely upon the observed galactic mass in the absence of dark matter or modified gravity equations. As will be shown, the statistical results show what we believe to be the undeniable and certain accuracy of the FFV model.

Such vortices within spiral galaxies would be indeterminable excepting for the rotating discs they produce as seen in lenticular and spiral galaxies. How they accordingly form, their strength, relative size, the distribution of matter that they produce, and often interactions within a large number of surrounding galaxies in a group or cluster, etc., produce their observable shapes. For this reason, some galaxies expectedly would have rotation profiles somewhat different from another almost identical appearing galaxy based upon the FFV model.

The Newtonian formula for Orbital motion:

The orbital diameter and velocity of a star within a galaxy vary in its path around the galactic center. This is because bounded orbits, where the gravity of a central body dominates, are generally elliptical in nature. Circular orbits approximate the standard formula for the velocity of stars in orbit within a spiral galaxy since a special case for elliptical orbits is a circular orbit. Circular stellar orbital velocities, when modeled, are the average of changing velocities of their elliptical orbits. The standard Newtonian formula to calculate such velocities is shown next: $\mathbf{v} = \frac{\mathbf{G} \cdot \mathbf{M}}{\mathbf{r}}$ [5], where v is the velocity of a star, $\mathbf{G}$ is a gravitational constant, $\mathbf{M}$ is the mass in kilograms, and r is the distance of the star from the center of the galaxy's mass in meters.

This standard form of the Newton equation is not used in this paper, but its re-arrangement. Equation (2) below is extensively used to calculate galactic mass and is the most frequently used equation of this paper. This is because our raw data consists of the graphs of Newtonian spiral galaxy rotation curves. If our raw data was instead the data used to create the galactic Newtonian velocity profiles in the first place, then the rearrangement of equation (2) may not have been necessary. But since Newtonian velocity profile graphs were needed for our calculations, our graph sources of data fit well with our model and equation (1).

The Newtonian formula used to determine galactic mass [17]

$$\mathbf{M} = \frac{\mathbf{v}^2 \cdot \mathbf{r}}{\mathbf{G}}, \tag{2}$$

where $\mathbf{M}$ is the galactic mass at a specified radial position, $\mathbf{v}$ is the velocity of the matter, r is the radial distance of the bin, and $\mathbf{G}$ is the Newtonian gravitational constant. This rearrangement will be used to determine the accuracy of the proposed formula concerning vortex velocities in the context of the subject vortex proposal.

Newtonian equation (2) is based upon the spherical distribution of matter interior to the radial position being calculated. Since the discs of spiral galaxies are generally circular rather than spherical, equation (2) by itself proves to be less accurate concerning extended radial distances so our method of calculation seems to better suit the required accuracy needed to verify the FFV model, as well as being far simpler to understand than other astronomy-related equations (22) as the reader will see in this text.

So we will use equation (2) and our combination equations 3-6 to calculate and predict line C and therefore the observed velocity profiles of spiral galaxies. The results of these calculations will be compared with equation (1) and observed velocity profiles. The predicted results will also be compared with the predictions of dark matter and modified gravity velocity profiles.

The "proportional" mass total for each bin having a specified radial range is calculated as a fractional portion of the total mass of the visible galaxy (the galactic disc):

$$\mathbf{Mp} = \left(\frac{\mathbf{v}^2 \cdot \mathbf{r}}{\mathbf{G}} \Big/ \sum \frac{\mathbf{v}^2 \cdot \mathbf{r}}{\mathbf{G}} \right).$$

This equation shows the proportional mass, Mp of each chosen radial bin location relative to the total mass observed on the galactic plane based on the Newtonian velocity profile, calculated by equation (2). As explained before, this is a dimensionless ratio since the constant G and the dimensions of velocities and radial distances cancel out in this quotient. So for all of our calculations, we do not need to use the G factor or any dimensions since we are only calculating the proportional mass of each bin to a dimensionless fraction less than 1.

This FFV equation calculates the portional bin mass of a galactic disc

$$\mathbf{Mp} = \mathbf{v}^2 \cdot \mathbf{r} \Big/ \sum \mathbf{v}^2 \cdot \mathbf{r} \,. \tag{3}$$

Besides equation (1), equations (3) through 10 are also unique to the FFV model, but similar results with more effort can be obtained using primarily equation (2) only with the inclusion of the G factor. Equation (3) is the same as equation (2) with the addition of a summation devisor, with the G factor being canceled out, along with the dimensional characteristics normally required by equation (2).

Since our equations and methods seem to be simpler, easier, faster, and far more accurate, we chose them for our calculations. Equation (3) is the primary equation we use to make our initial velocity profile assessments. The devisor of this equation is the summation of all the numerators, which is the sum of the calculations of equation (2) with the G factor canceling out by division. By equation (3) calculations, each chosen bin represents the fractional mass on the galactic plane of the visible galaxy at that chosen radial position. The selected radial distances of these separate bins are based upon having at least four, and preferably more bins on the galactic plane. Each bin represents a fraction of the whole and is dimensionless since the gravity factor G divides out in this fraction. As a result, the fractional mass of each bin will be calculated by $\mathbf{v}^2 \cdot \mathbf{r}$, and will always be less than 1. This calculation is simple and no more data is needed for these initial calculations as will be shown.

The radial distances and separation of bins in our calculations are made to simplify calculations when possible, and are generally chosen from the outside of the galaxy inward, with consideration of the radial length of the visible galaxy. To simplify calculations radial distances in kiloparsecs are often multiples of 5 or 10. Two of these sums of relative mass calculations will later be designated as $\mathbf{P}_1$ and $\mathbf{P}_2$ for the total mass calculation of equation (6). The equation of these summations is equation (5). For the calculation of galactic core mass with a spherical distribution, the mass inside radius $\mathbf{r}$ is given by Newtonian related equation 4.[18]

Deriving equation 4

The area inside any circle is $\pi \cdot \mathbf{r}^2$. The volume inside a sphere is $(4/3) \cdot \pi \cdot \mathbf{r}^3$. The factor difference between the two is $(4/3) \cdot \frac{\pi \cdot \mathbf{r}^3}{\pi \cdot \mathbf{r}^2} = (4/3) \cdot \mathbf{r}$. But unlike Newtonian gravity, spiral galaxy core velocities generally increase in direct proportion to their radial distances, rather than following the Newtonian formula $\mathbf{v} = \mathbf{G} \cdot \mathbf{M} / \mathbf{r}$.[5], where velocities fall off with increased radii. So for $\frac{1}{2}$ the radial distance within the core, velocities are also about $\frac{1}{2}$ their peak. Because of this, we found that the mean radial distance of the core $\frac{1}{2} \cdot \mathrm{r}$, is a much more accurate increase-factor than $\mathbf{r}$.

Our core mass calculation formula then becomes

$$\mathbf{Mb} \approx 1.5 \cdot \mathbf{r} \cdot \mathbf{v}^2; \tag{4}$$

$\mathbf{v}$ is the velocity at the first bin location. This bin is the first bin within the disc and should be chosen to be just outside the core, and r is the radial position of that bin.

In equation (3), by division, after the factor $\mathbf{G}$ has been eliminated, the numerator for calculating the relative mass of the core is simply $\mathbf{Mb} \approx 1.5 \cdot \mathbf{r} \cdot \mathbf{v}^2$.

The reader should notice the approximate sign above ($\approx$) instead of the equal sign for all of the other equations. This is because the cores of spiral galaxies vary in their size, density, form, and proportion relative to spiral galaxies as a whole. In the FFV model, the same assumption that the core mass absorbs the entire incoming vortex velocity cannot be made. In some cases, the core can absorb the entire vortex velocity, but in others, a residual velocity can remain, which would further rotate the galactic center.

Reader should be reminded that the primary reason for the FFV model as well as the modeling for dark matter, modified gravity models, or any other model, is to show the evidence and validity of the model, not to actually make exact predictions of the matter distribution of these galaxies. Only the FFV model can do this as will be explained for equation (7).

Equation (5) calculates the total relative bin mass. It is the sum of all the proportional bin masses of the galactic plane including the core, but excluding the G denominator for each addendum:

$$\mathbf{M}\mathrm{tb} = 1.5 \cdot \mathrm{r} \cdot \mathrm{v}^2 + \sum\left(\mathrm{v}^2 \cdot \mathrm{r}\right). \tag{5}$$

$\mathbf{M}\mathrm{tb}$ is the sum of all the bin masses excluding the G denominator. The equation needed to calculate the fractional mass of each bin relative to the total galactic mass requires an additional factor, which would include the mass on the galactic plane beyond what is visible, as well as the mass above and below the galactic plane that would affect velocities on the galactic plane. This additional factor we designate as Maf, which stands for an **A**dditional **F**actor of **M**ass, which accordingly calculates all the mass that influences spiral galaxy rotation velocities.

Equation (6): This FFV formula calculates the proportional bin mass for each chosen bin radius of the galaxy.

$$\mathbf{M}\mathrm{pt} = {}^{\mathbf{M}\mathrm{tb}}\!/\!_{\mathbf{M}\mathrm{af}}. \tag{6}$$

Equation (6) is the same as equation (3) excepting for the additional mass addendum factor $\mathbf{M}\mathrm{af}$ added to it. $\mathbf{M}\mathrm{pt}$ *is the __p__roportional __m__ass __t__otal of each bin* based upon the calculated total mass of the galaxy. It is the equation used to make most of the calculations of the FFV model.

But to be able to use this equation we must first calculate the Maf factor. This is accomplished by equation (7), which was derived from the hypotheses explained below.

Equation (7) below is needed to calculate the mass addendum factor **M**af of a spiral galaxy. This factor is needed to calculate the total galactic mass of the galaxy, which affects rotation velocities. This equation is used to calculate the mass beyond the observable spiral galaxy on the galactic plane, and the matter above the galactic plane, which affects the rotation velocities of the galaxies disc stars.

Note: Derivation of equation (7) is based upon the proposition that the galactic mass outside the galactic plane, stellar clusters and cloud matter etc., influence the rotation velocities of stars on the galactic plan in direct proportion to their mass, and generally in accord with their radial distances from the galactic plane. How much of such matter exists can accordingly be calculated and determined from the rotation velocities of the galactic disc stars according to this model.

As always, a proof of an equation's validity is in the accuracy of its predictions, as will be shown. This equation is also based upon the proposition that only the galactic mass of the observed galactic disc is needed to calculate the total galactic mass and its velocity profile. This equation requires two data points from the observed velocity profile to determine the total galactic mass that accordingly affects disc rotation velocities. As we have seen, the greater the separation between these 2 points of equation (1), the greater the likelihood of improved accuracy:

$$\mathbf{M}\text{af} = \frac{(\mathbf{V}_2/\mathbf{V}_1)}{\left[\mathbf{P}_2/(\mathbf{P}_2 - \mathbf{P}_1)\right]}. \tag{7}$$

MAF is the Mass Addendum Factor. The two chosen velocities $\mathbf{V}_2$ and $\mathbf{V}_1$ are from the observed velocity profile line B, minus the Newtonian velocity at those same radial positions *as determined by equation (1)*. The proportional bin mass sums $\mathbf{P}_1$ and $\mathbf{P}_2$ are designated as **M**pt in equation (6), at $\mathbf{P}_1$ and $\mathbf{P}_2$ radial bin locations respectively.

The equation to determine the total galactic mass that affects the rotation velocities of the galactic plane then becomes the product of $\mathbf{M}\mathrm{af}$ and $\sum \mathbf{v}^2 \cdot \mathbf{r}$, which is the denominator of equation (5):

$$\mathbf{M}\mathrm{pt}(\mathrm{p1}) \cdot \mathbf{M}\mathrm{pt}(\mathrm{p2}) = \mathbf{V} \cdot \mathbf{O}_1 / \mathbf{V} \cdot \mathbf{O}_2 . \quad (8)$$

This is the calculation needed to determine the vortex velocities of the FFV model; $\mathbf{M}\mathrm{pt}$ is calculated by equation (6). Two different bins $\mathbf{P}_1$ and $\mathbf{P}_2$ are the same as $\mathbf{M}\mathrm{pt}$ but represent, as explained for $\mathbf{P}_1$ and $\mathbf{P}_2$ above. The calculated vortex velocities $\mathbf{VO}_1$ and $\mathbf{VO}_2$ are at the same radial bin locations as $\mathbf{P}_1$ and $\mathbf{P}_2$. The chosen (arbitrary) bin locations $\mathbf{P}_1$ and $\mathbf{P}_2$ are for this calculation, where $\mathbf{P}_2$ is greater than $\mathbf{P}_1$. Either $\mathbf{VO}_1$ and $\mathbf{VO}_2$ must be calculated using equation (1), designated there as $\mathbf{Vv}$.

Equations (7) and (8) were derived from the assumption that the background field vortex velocities are directly proportional to the normal matter (baryonic matter) of the galaxy. This initial assumption we now consider a hypothesis, which has been tested and proven for many dozens of randomly chosen spiral galaxies, without exception, showing almost certain validity or the FFV model based upon its predictive certainty and the related correlation statistics that will be shown and explained below.

The $\mathbf{M}\mathrm{af}$ factor of equation (7) acts as an equalizing factor for any error in the bin calculations based upon inaccurate input data, or calculation error, especially for the core bin mass, where the error difference would be made up by a variation in the $\mathbf{M}\mathrm{af}$ factor. As a result, the proportional bin mass calculations for all other bins will be accurate.

The reason for this hypothesis is simply explained by the decrease and absorption of the background field vortex velocity by matter, and the increase in the velocity of the matter as they encounter each other.

The last equation that can be used to determine the predicted velocity profile is equation (9):

$$\mathbf{VO}_\mathrm{i} + \mathbf{Nv} = \mathbf{Ov} . \quad (9)$$

This equation states that the vortex velocity at any bin radius, **VOi**, when added to the Newtonian velocity, $\mathbf{Nv}$, at the same bin radius, will equal the average observed velocity at that same radial bin location. This equation is obvious and not needed or used for this proposal since all predictions are more easily made and become more visually apparent on the vortex velocity profile line C, calculated and formed by equation (1), as explained many times above.

Equation (10) can be used to calculate a second set point, as a proof-of-concept equation for galaxies with flat rotation curves, and/ or have rigid body vortices [19] like the Milky Way, or have a consistent vortex slope. It is used to show that a second set point is not needed for such galaxies. To choose this equation one would need to use equation (1) beforehand to know what kind of vortex profile the galaxy has. For this reason, although simpler in these cases, we did not use this equation for any of the calculations in this study:

$$\mathbf{V}_2 = \left(\mathbf{P}_2 / \mathbf{P}_1\right) \cdot \mathbf{V}_1 \qquad (10)$$

Where $\mathbf{P}_2$ is greater than $\mathbf{P}_1$, and both were the chosen radial positions for calculation. Although most any two chosen radial distances would work as well, radial positions wider apart can often lead to slightly better accuracy. All velocities are in km/sec. $\mathbf{V}_1$ is the chosen radial position and set point for starting calculations.

3.1 Graphs and calculations. Applying the equations to predictions of the FFV model for the 17 randomly chosen spiral galaxies.

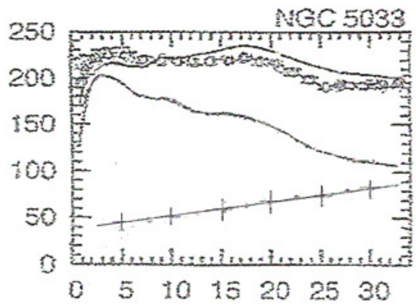
Concerning the galaxy graphs below, Galaxies NGC 5033, 4088, 4183, 3726, 5533, 4100, 6503, 2403, 2998, 3198, 3893, 4157, 4138, 6674, 6946, 2841, F568-3 will follow.

Based upon readers' comments, it has been difficult for some to realize that the galactic predictions are being made on the bottom line of the graphs, line C. If this is still not understood by a reader at this point it would be better to go back in the text to understand the significance of line C as the galaxy velocity predictor, as explained in section 3, figure 2, equations (1), and (6).

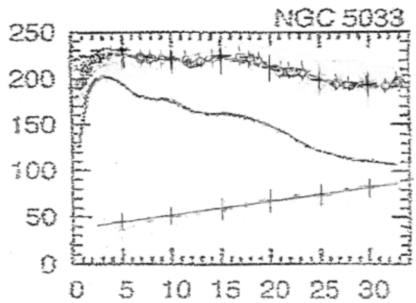
Line C, the bottom line in these velocity profile graphs, for figure 9, again is the predictor of the observed velocity profile when added to the Newtonian velocity profile line A. Putting the prediction on the top line, the observed velocity profile line, as in galaxy NGC 5033 above, and NGC 4138 below, generally have less clarity when projected on to the observed velocity profile, line B, then on line C, the proposed velocity profile. So we believe the graphing and predictions on line C are easier to distinguish and therefore better.

For all the graphs below radii are shown on the bottom scale as distances in kiloparsecs, and velocities are shown on the left vertical scale in kilometers per second.

Figure 3



Radii in kiloparsecs
This is the original chart with the Brownstein and Moffat prediction line on the top.



This is the same chart as seen on the left, with top line of the Brownstein and Moffat prediction omitted. Instead it has the FFV predicted velocity profile projected onto the top observed velocity profile line. Also; this is an almost perfect prediction that for some readers might be easier to understand than the dots and crosses of line C.

Velocities calculated by equation (1),
X = 40 45 58 66 75 82 92
Velocities calculated by equations (8),
Y = 43 49 58 68 76 84 92

Spiral Galaxy NGC 5033

How did we choose the spiral galaxies shown below in this study? We randomly chose small, medium, and large spiral galaxies. We tried to get all sizes and types of spiral galaxies for our study. Although small spiral galaxies can also be easily be predicted by the FFV model, they usually are not a good test of the model since there usually is little detail in their velocity profiles, so that both dark matter and modified gravity models can also closely predict their smooth, flat, or rising velocity profiles. Such a galaxy in our study is F568-3, as seen below.

Instead, we looked for galaxies that showed some detail in their Newtonian profiles since this is where all the data for calculations is coming from in the FFV model. We also looked for observed velocity profiles that had enough data (containing at least 60% of the galaxy) when comparing their peak velocities with their radial extension. We had maybe twice as many galaxies to choose from that met these criteria, but thereafter the spiral galaxies chosen were simply a random selection of different types and sizes of spiral galaxies.

For all graphs of spiral galaxies that will follow, horizontal distances are shown in kiloparsecs on the horizontal lines below, and the left vertical lines show velocities in kilometers per second.

Newtonian and observed profile lines that curve up and down at similar radial distances like NGC 5033 is what would be expected by any model that the observable galactic matter determines a galaxy's observed velocity profile. So with such a detailed example as figure 9, we will calculate the relative mass of the galaxy, and using our equations predict the observed velocity profile.

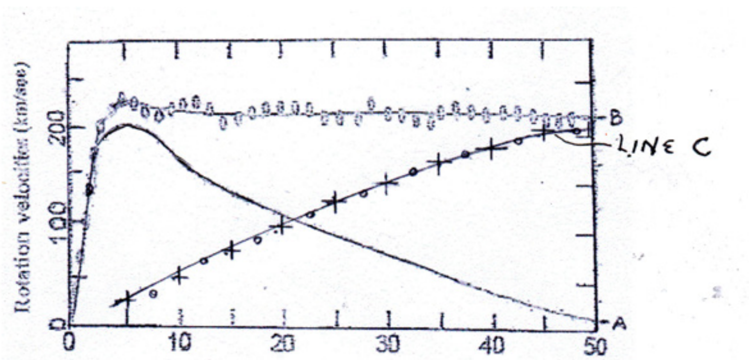
Table 1

1	Distances in kiloparsecs	5,00	10,00	15,00	20,00	25,00	30,00	35,00
2	Newtonian velocities	195,00	176,00	164,00	150,00	122,00	112,00	105,00
3	Newtonian velocities squared	38,03	30,98	26,90	22,50	14,88	12,54	11,03
4	½ r^2 times row 3	285,19	309,76	403,44	450,00	372,10	376,32	385,88
5	Sum of row 4, left to right	285,19	594,95	998,39	1,448,388	1,820,488	2,196,808	2,582,683
6	Difference between 2,582,683 and row 5	2,297,495	1,987,735	1,584,295	1,134,295	762,20	385,88	
7	Decrease in vortex	-53.6	-46.4	-37.0	-26.5	-17.8	-9.0	
8	Calculated vortex velocities	**38.4**	46.4	**55.0**	65.5	74.2	83.0	**92.0**
9	***Equation (1)*** $V_V = O_V - N_V$	40,00	45,00	58,00	66,00	75,00	82,00	92,00
10	Row 4 shifted one column to the left	309,76	403,44	----	450,00	372,10	376,32	385,88
11	Row 10 divided by 4,210,233	-7.4	-9.6	0.0	+10.6	+8.8	+8.9	+8.4
12	Calculated vortex velocity profile	**38.6**	**47.4**	**58.0**	**68.6**	**77.4**	**86.3**	**94.7**
13	Same as row 9	**40,00**	**45,00**	**58,00**	**66,00**	**75,00**	**82,00**	**92,00**

Calculations for galaxy 5033

The above table shows the results of calculating equations (6) and (7) for galaxy NGC 5033. Understanding the above table: **Row 1** are the bin radial distances in kiloparsecs; **Row 2** are the Newtonian velocities, line A on galaxy graph, scaled from figure 3 above, galaxy NGC 5033. **Row 3** shows Newtonian velocities squared from row 2. **Row 4** is the product of lines 1 and 3. **Row 5** is the sum of row 4 from left to right. **Row 6** is the difference between the proportional mass shown in row 5, subtracted from the total proportional mass column 7,_2,582,683. For instance column 1 row 6 would be 2,582,683 minus 285,188 (row 5). Column 2 row 6 would be 2,582,683.minus 594,948. Column 3 would then be 2,582,683 minus 998,388. etc. **Row 7** is the calculated incremental decreases in vortex velocities downward from 92 km/sec. Row 6 divided by **4,286,916**., the total galactic mass calculated by equation (6). **Row 8:** These calculations are based on equation (8). **Row 9** shows the calculated vortex velocities based upon equation (8) and the incremental changes of row 8. The same vortex velocities in **Row 9** are shown in row 8, but instead calculated by equation (1). **Rows 10 through 12** are not needed for our vortex calculations. Their purpose here is to show that any starting bin location can be chosen and used for calculations. We call these starting points, the "set- point" for calculations. For all of our calculations in this paper, the chosen set-point was the farthest radial bin location from the galactic center. But for rows 10 through 12 we chose a central bin location/ set-point, at 15 kiloparsecs. Rows 10 through 12 show the calculations for this set point instead of the original set point of 35 kiloparsecs. When comparing row 8 with row 12 one can see the small calculation differences that occur when using a different set point (starting point). Row 13 is identical to row 9. These are the calculations from equation (1), both placed for easy visual comparison with the calculations of equation (8) above them. Notice the very small difference between the velocities calculated in rows 8 and 9. These are the figures used for the determination of statistical correlation. Set-points are not included in the statistical calculations. Equation (1) data, line 9, is first determined by physically scaling the graphs drawn by Brownstein and Moffat, specifically lines A, the Newtonian velocity profile averages, and line B, the observed velocity profile averages [4]. Velocities used for equations (5) and (6) are also determined by the scaling of velocities on the same graphs. Notice the very small difference between the velocities in rows 8 and 9. Row 8 shows the calculations from equations (5) and (6), and row nine shows the calculations from equation (1). The small difference between the two is usually no greater than the accuracy range of the input data. This is a typical example of the accuracy of these velocity profile predictions, which we believe strong evidence for the validity of the FFV model. As can be seen from the calculations above, using two data points from equation (1) most often leads to slightly more accurate calculations concerning equations (4), (5), and (6). For these galaxy graphs, notice the difference in clarity between crosses on the observed velocity profile line, and those below on the vortex velocity profile. Any variations from predictions are usually easier to distinguish on line C, the predicted vortex velocity profile, when added to the Newtonian profile line A, yields line B, the observed velocity profile, the top line. Note that the X and Y velocity determinations shown on the graphs must be calculated for the same radial distances to have a valid statistical comparison between the results of equation (1), and those of equation (7). Velocity calculations are not shown for the galaxies that follow to control the text length, but all are available upon request. The velocities calculated from equation (1) are shown as the 'X' values, and the velocities calculated from equation (6) are shown as the 'Y' values.

Figure 4

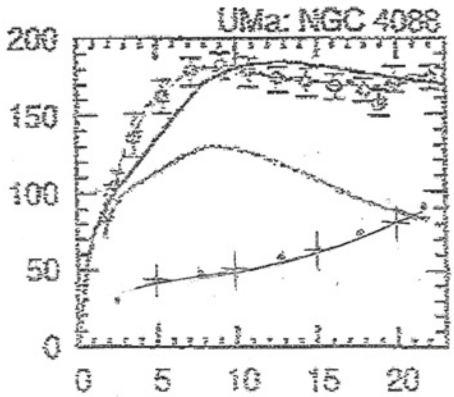


X = **22,52,74,96,123,148,165,185,205,208**
Y = **25,52,74,99,123,143,165,187,207,208**

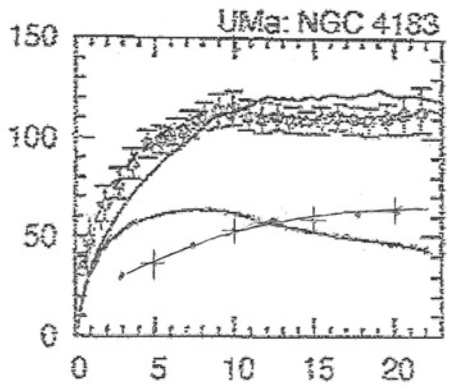
The Milky Way Velocity Profile and calculated predictions line C

Radial distances of calculations are shown at the ‘Y’ values shown as crosses. Between the calculated ‘Y’ values are additional ‘X’ values shown as points so that one can see how close these two calculation results are to each other and in determining the observed velocity profiles. Both calculations cannot be shown at the same radial positions, as shown in the calculations since they are either the same or too close together to distinguish the difference.

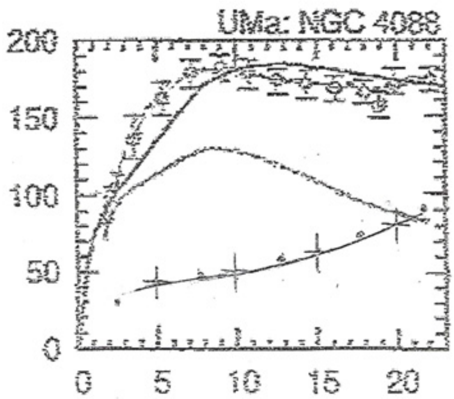
Figure 5,



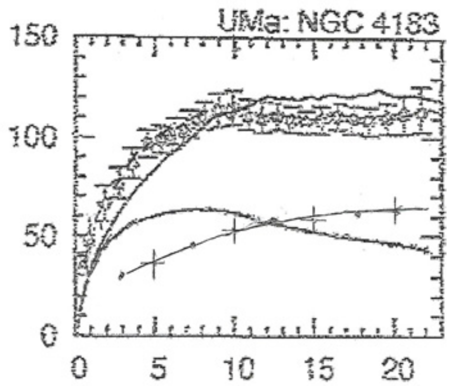
X = 45, 52, 64, 79
Y = 42, 49, 62, 79



X = 37, 53, 58, 63
Y = 38, 50, 62, 64



X = 35, 45, 58, 68, 82, 97
Y = 28, 48, 55, 65, 80, 100

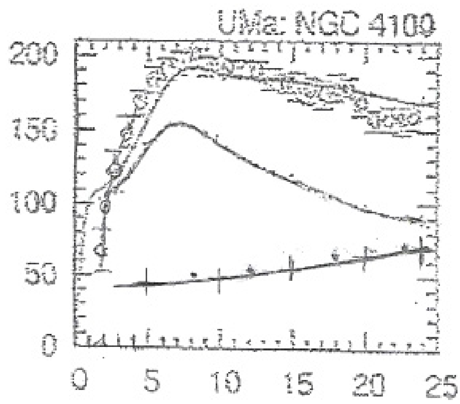


X = 68, 88, 92, 94, 102,120,125
Y = 76, 88, 90, 94, 105,118,128

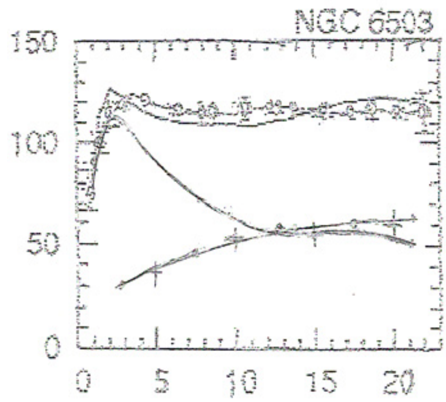
Includes all the other graphs and velocity profile predictions of this study.

Dark matter modeling can only accurately model spiral galaxies resulting in flat rotation curves with large core radii. This is because of the great quantity of dark matter needed for such modeling. Above are two galaxies that because of their rising and falling observed velocity profiles would be totally unsuitable and inaccurately modeled by dark matter modeling. Less than 1/5th of spiral galaxies are suitable for dark matter modeling based upon our study, which we think can readily be realized just by the appearance of the ups and downs in the observed velocity profiles of the two galaxies above.

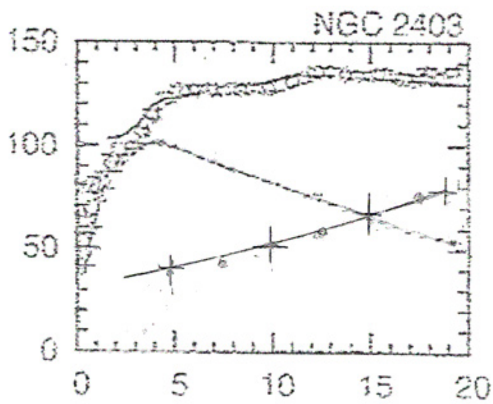
Most galaxies do not have a flat or up-sloping observed velocity profile, which is the general result of dark matter modeling, therefore most are not predictable by dark matter modeling.



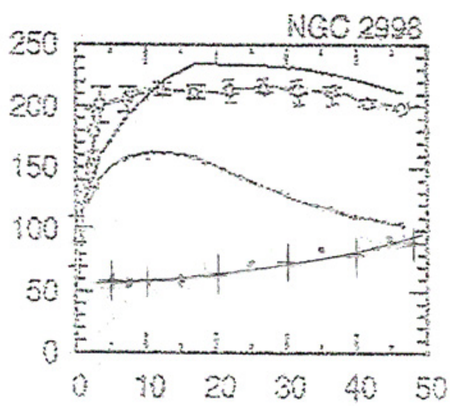
X = 44, 52, 56, 65, 70
Y= 46, 56, 58, 66, 72



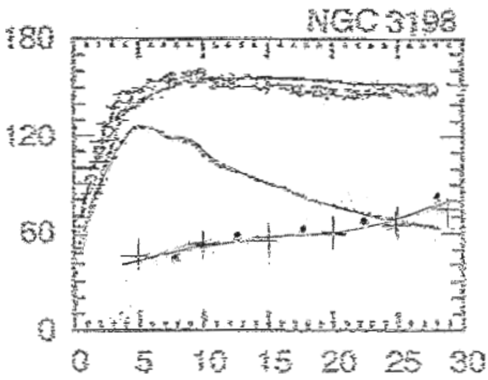
X = 36, 52, 58, 61
Y = 38, 50, 60, 62



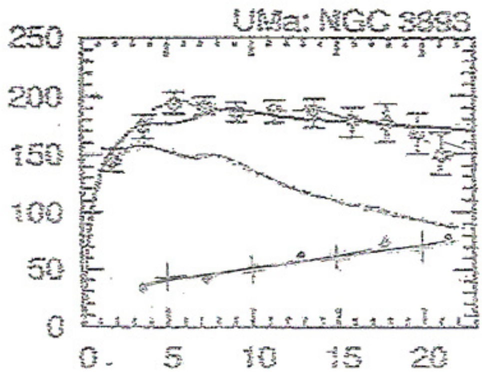
X = 39, 52, 68, 78
Y = 38, 53, 68, 80



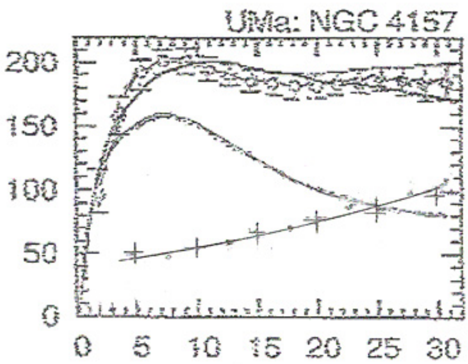
X = 60, 65, 72, 80, 92
Y = 62, 65, 69, 83, 95



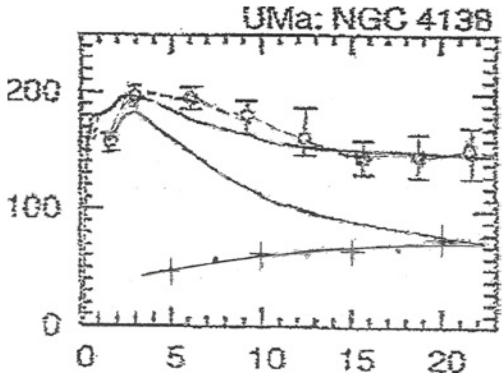
X = 48, 55, 58, 63, 67, 76
Y = 45, 54, 61, 66, 68, 78



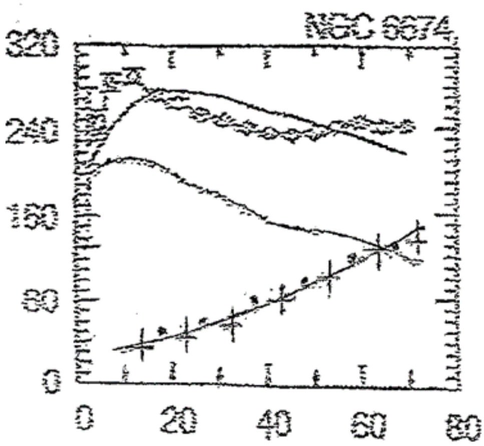
X = 45, 50, 58, 71
Y = 42, 50, 60, 76



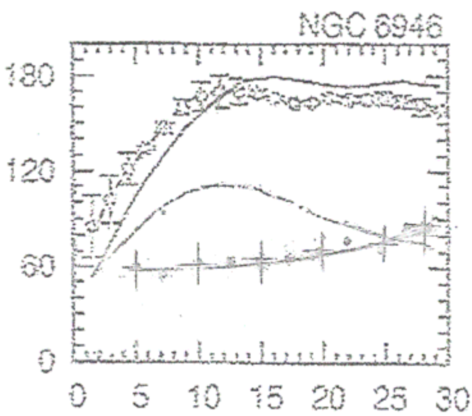
X = 52, 58, 68, 78, 83, 98
Y = 50, 58, 66, 75, 87, 104



X = 58, 68, 73, 77
Y = 58, 65, 72, 75

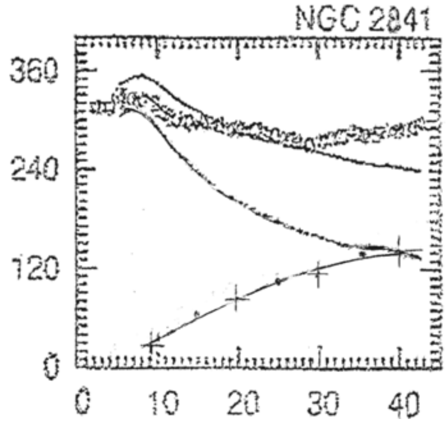


X = 38, 46, 59, 71, 84, 106, 135
Y = 35, 44, 56, 70, 84, 108, 130

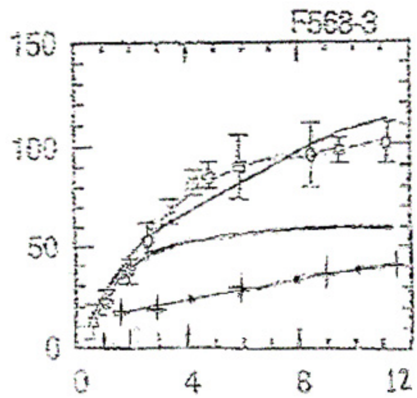


Y = 62, 63, 65, 67, 80, 85
X = 62, 64, 65, 66, 81, 84

Galaxy 4138, based upon its visual appearance, seems like a generic spiral galaxy but dark matter because of its velocity downturn from 200 km/sec. at its peak to 150 km/sec cannot accurately model it. This is because about 20% of its stars are counter-rotating in the opposite direction to most of the other stars of the galactic disc. For this reason, it may not be a good test of the validity for any model concerning velocity profile predictions. We have included it as a random choice. It is predictable by the FFV model but similar counter-rotating galaxies may not be as predictable by our model.



X = 28, 87, 118, 138
Y = 25, 88, 115, 140



X = 18, 24, 30, 36, 40
Y = 18, 22, 30, 35, 40

The standard formula, equation (11), calculates the **Pearson correlation coefficient *r*** [20], the correlation between the spiral galaxy velocities observed, and those that are predicted based upon equation (6), for the 17 randomly chosen spiral galaxies calculated in this paper. The primary purpose of these calculations is to provide strong evidence to show the correlation between the observable velocity profile of a spiral galaxy and its calculations based upon the formulas of the FFV model, and verification of the model. The second purpose is to show the accuracy of the FFV model based solely upon the observable matter of the galaxy as calculated from its Newtonian velocity profile.

3.3 Statistical Analyses of predictions.

The Pearson correlation coefficient **r**[10]: This is the standard equation used in statistics to determine the correlation between two sets of data, one characteristic or calculation data set to another. In our case, we examine the correlation between the velocities calculated by equation (1) and those calculated by equation 8. All of the above spiral galaxy graphs show both sets of data. The ‘X’ values denote the calculations of equation (1) and the ‘Y’ values are calculated by equations 6 for the above spiral galaxy velocity rotation curves. Note that the X and Y velocity determinations shown on the graphs must be calculated for the same radial distances to have a valid statistical comparison between the results of equation (1) and those of equation (7). This cannot be shown on the graphs above since the values are often the same or too close to identify the differences at the same bin location.

$$\mathbf{r} = \frac{\sum_{i}^{n}(\mathbf{x}_i - \bar{\mathbf{x}}) \cdot (\mathbf{y}_i - \bar{\mathbf{y}})}{\sqrt{\sum_{i}^{n}(\mathbf{x}_i - \bar{\mathbf{x}})^2 \cdot (\mathbf{y}_i - \bar{\mathbf{y}})^2}}, \qquad \textbf{(11)}$$

where

- the Pearson correlation coefficient $\mathbf{r}$
- the number of observations tested n,
- the sum of the products of paired scores $\sum \mathbf{x} \cdot \mathbf{y}$,
- the sum of $\mathbf{x}$ scores for variable $\mathbf{x}, \sum \mathbf{x}$,
- the sum of y scores for variable $\mathbf{y}, \sum \mathbf{y}$,
- the sum of squared $\mathbf{x}$ scores $\sum \mathbf{x}^2$,
- the sum of squared $\mathbf{y}$ scores $\sum \mathbf{y}^2$.

The standard Interpretation of the results from calculating the Pearson Correlation Coefficient ‘r’

- Strength of Association and correlation:
- Small Positive $[0.1 \div 0.3]$; Negative $[-0.1 \div 0.3]$;
- Medium Positive $[0.3 \div 0.5]$; Negative $[-0.1 \div -0.3]$.

Calculations for all the calculated data bins shown on the graphs of the 16 galaxy velocity profiles presented in this study, not including the Milky Way, have been made and averaged. Statistical calculations comparing the ‘X’ data to the ‘Y’ data values given for each galaxy calculated above can be easily calculated by using the calculation link below or another such link calculating the Pearson Correlation coefficient. The calculated https://www.socscistatistics.com/tests/pearson/default2.aspx (Accessed 19.06.2023).

Pearson Correlation Coefficient average for all of these galaxies is $\mathbf{r} = +.98$. As can be seen above, this positive correlation is about as large as it could possibly be since it is within the range limits of the input data. It is wondrous how accurately both the observed and Newtonian velocity profiles have been determined by astronomers Brownstein and Moffat concerning their data set that we used for our study, based upon the distances and the observation angles involved for some galaxies. The Milky Way graph was excluded from this correlation summary because we made it ourselves as a composite graph, from what we believe to be the most accurate consensus data available. But the calculations of our galaxy's velocity profile shows it to equally correlate its accuracy concerning FFV predictions as for all the other galaxies presented, as seen in figure 4. 3.4 Testing and predictions of the FFV model Although calculations methods and predictions of the FFV model have been a major part of this paper, our purpose has nothing to do with actual predictions since the observed velocity profiles of the spiral galaxies examined, were already known. Instead, the single purpose of this, and for all other models, is to show evidence for the validity of that model. For the FFV model, we use at least two tools to determine the validity of the model. One is our equations, which when applied exactly predict the observed stellar velocities of spiral galaxies, and the second method and tool we used were correlation statistics between the observed galactic matter and the stellar velocity predictions. No other model can come close to the accuracy we have obtained using these tools based upon a large number of randomly chosen spiral galaxies in our research. F**uture predictions** shown below: All future predictions of the FFV model are both verifiable and falsifiable. There are many ways to test the FFV model by observation. According to the FFV model, background field-flow is three-dimensional; it enters galaxies and clusters in a spherical manner from all directions. Higher background field pressures accordingly exist between galaxies and clusters, with lower background-field pressures surrounding galaxies and their matter. **Prediction:** For both galaxies and clusters, generally the most rapid velocities as a result of field flow will most often be on the periphery of both galaxies and clusters. As explained for spiral galaxies, simply determine the Newtonian velocity at the periphery of the observable galactic disc, subtract the average Newtonian velocity at that radial position, and the difference will be the field flow velocity upon entering the visible galaxy. **Prediction:** Based upon the FFV proposal, a similar process should be usable for elliptical galaxies and galaxy clusters. Calculate the Newtonian velocity at the farthest observable radial location of the galaxy or cluster, subtract the calculated Newtonian velocity at that radial position, the difference should be the field flow velocity upon entering the visible galaxy or cluster at that radial distance. Unlike galaxies, field flow velocities of clusters should not necessarily have the same velocities because clusters will seldom have radio symmetry concerning their mass and galaxy members. For both, however, field-flow velocities near the gravitational center should be comparatively small, as actual velocities near central locations will be close to Newtonian. Calculating the exact velocities of spiral galaxies has been explained in great detail above, but elliptical galaxies were not discussed since they were no part of this study since observation data is sparse. It's difficult to see inside elliptical galaxies, but the velocities of stars on the galaxy's exterior can often be determined. **Predictions**: Based upon the field-flow model, peripheral stellar velocities of elliptical galaxies will nearly always be greater than calculated Newtonian velocities at these exterior radii, but rarely uniform or as rapid as peripheral velocities of spiral galaxies of similar masses. Internally velocities of stars of elliptical galaxies would also be greater than Newtonian velocities. In a few cases, elliptical galaxies could have flat rotation curves similar to many spiral galaxies, at least for as far inward as one could observe. For FFV evaluation, preferred galaxy cluster observations would be those that from our perspective would appear somewhat edge-on, where we can still generally see the majority of the cluster, where the cluster is somewhat condensed, and where many of the galaxies of the cluster can be observed to generally orbit in a common plane. **Prediction:** For these clusters, galaxies on a common plane can orbit much faster than those galaxies outside of this plane, which have the same radial distances from the gravitational center of the cluster. This effect would be the result, accordingly, of an internal vortex and its background-field flow. **Prediction:** There are field flows between galaxies in a cluster. There will be central points between two or three galaxies where the background field will flow outward in different directions from these higher field density and pressure volumes, toward the lower field-pressure volumes of the two or three involved galaxies. Strong galactic or cluster light coming from behind the cluster at these points can greatly be distorted from our perspective, now attributed to gravitational lensing, where no close source for large gravitational lensing can be observed. Of course, these points of light aberrations from our perspective will change as the relative position of galaxies in the cluster change over long periods of time. **Prediction:** For irregular galaxies and some stellar clusters, velocities of stars can be greater than Newtonian velocities could allow. Stars with excess velocities greater than Newtonian velocities will be both caused and retained by the inflowing background field based on the FFV model. Some small, old-appearing, sometimes spread-out irregular galaxies will often only have Newtonian velocities. **Prediction:** There will be a great many more large "dark" spread-out galaxies that are almost unobservable now because of their dimness, both near and far, as well as a full range of galaxies of lesser brightness. Of these dark galaxies, mostly high-mass dim red stars will be observable. But many of such galaxies will have a majority of smaller red stars, red dwarfs, white dwarfs, brown and black dwarfs, and numerous stellar black holes. Few of these galaxies will be observable via radio emissions except for neutron stars. Their central galactic black hole will be generally quiescent. A great many more of these old spread-out galaxies will be observable by the James Webb infra-red scope when it is functioning. Their loss of brightness results in their loss of an inflowing field, which enables these galaxies to spread out. **Predictions** totally contrary to dark matter: If the velocity profiles of such galaxies cannot be determined because of their dimness, mainstream astronomy will assert that these galaxies are almost entirely made up of dark matter. But if their velocity profiles can later be determined, astronomers will realize their velocity profiles are almost entirely Newtonian meaning there would be little or no non-baryonic dark matter within them. **Prediction:** As galaxies age (some possibly much older than present cosmology could allow), their dimness would greatly reduce inward field-flow allowing the galaxy to disperse outwardly and dissipate, according to the FFV model.

4. Limitations of the FFV and other models

Before we get to the general conclusions of this paper we will discuss some limitations and comparative analysis of the FFV model. The FFV model proposes that two spiral galaxies of exactly the same total galactic mass and mass distribution will not necessarily have the same vortex strength, although the variation of the vortex strength would be the same if the mass distribution is the same. This would be because galactic mass would not be the only determinant of vortex strength. This accordingly would be because the vortex strength of spiral galaxies would be a function of many other variables, such as the age of the majority of its stars, its luminosity, and variations of its radiation spectra, its mass density, its relative position, and orbital motion within its group or cluster, the clusters position and motion relative to its surroundings, counter-rotating stars within it, the counter-rotation of the galaxy as a whole, etc. Some of these variable relationships are not unique in that all astronomers know of the Tully-Fisher relationships, which can explain the relationship of spiral galactic brightness to their peak velocities, its mass to its peak velocity, etc. None of these variables accordingly affect calculations for the FFV model, because our vortex velocity profile calculations include the influences of all such variables without their separate determination, as explained within the text. Like all velocity profile calculations and their predictions, the FFV model requires at least one set point within the observed spiral disc as a reference and starting point to calculate the best-fit galactic disc mass and other factors needed for predictions. This is also true for dark matter modeling and other alternative models. But generally speaking, the FFV model requires two set points to make exact predictions within the error limits of the input data, because the FFV model calculations must include the galactic mass outside the plane of the galactic disc, which affects disc velocities. When just a single reference point is used for the testing of the FFV model, a second set point would not be needed if the galaxy is known to have a flat rotation profile. But if not, often a second set point can be very accurately estimated from the Newtonian velocity profile. The lack of an observation-based second set point, in many cases could somewhat decrease the accuracy of FFV prediction for that galaxy. Such predictions would still be far better than dark matter predictions, and still expectedly better than modified gravity predictions. A second set point, however, would not improve inaccurate dark matter modeling of spiral galaxies because of the vast quantity of dark matter required. Modified gravity models, like the FFV model, almost always make better predictions than dark matter models of spiral galaxies but would be expected to make even better predictions having two set points from the observed velocity profile to enable a statistical least-mean-square regression analysis of their prediction. We did not attempt to predict the mass distribution within spiral galaxy cores since it would not improve our exact predictions. An equation is given within this paper to accurately estimate the total core mass of spiral galaxies using both the Newtonian and the observed velocity profiles for its calculations. The FFV model asserts that core vortex velocities decrease inward from the core exterior and are mostly absorbed by the core mass interior. Core vortex velocities, aside from finally being absorbed by the core mass, unabsorbed vortex velocities could sometimes remain according to our study, which can rotate the core as a whole to some extent, meaning that in such cases all parts of the galaxy and core would be rotating compared to the background of distant galaxies, concerning its proper motion. Although velocity calculations of stars and matter can be made beyond the visible spiral galaxy radius, these calculations are more difficult to make but still can be exactly calculated for the Milky Way as in our example. But we have no such extended data for other galaxies in this study since such data is generally not available from any source because of the distances involved. Of course, extended mass data could be estimated with less accurate results for any model calculating velocities at extended radial distances beyond the visible galaxy. Field flow predictions can accordingly involve other types of galaxies. Lenticular galaxies have the same core and disc forms as spiral galaxies without any spiral form to them. Since we couldn't find any mass-distribution data for lenticular galaxies we could not include lenticular galaxies in our study. For the most part, astronomers generally cannot peer within large elliptical galaxies to determine the interior velocity of many of its stars, therefore no data is available for any model to make velocity profile predictions of elliptical galaxies unless exact mass-distribution data is available, and also observed velocity profile data is available to check predictions. For irregular galaxies, the distribution of matter usually has no pattern to it, which generally leads to some or many unpredictable stellar velocities using any model.

5. Summary Conclusions and Questions

Based on the above study, the summary conclusions of this paper are:

1. The Field-Flow and Vortex model and the dark matter proposals both would add an unknown entity to the universe, but this research explains the big advantages of the FFV model over dark matter. First, the FFV model displays almost indisputable accuracy for nearly all spiral galaxies, far better than dark matter models, with predictions better than any other model. Second, dark matter only about 1/5th of the mass addendum requires the mass equivalence value of the energy addendum to the universe proposed by the FFV model. Third, the energy addendum needed for FFV predictions and its locations can be precisely calculated for each galaxy where the amount of dark matter required varies greatly from one galaxy to the next. Forth, at the largest scale of the universe concerning galaxy clusters, observation anomalies that presently seem inexplicable based upon dark matter, are expected, explainable, and predictable by the FFV model. Fifth, both dark matter and background field flow propose a means by, which galaxies and galaxy clusters could have created the beginning universe at a much faster rate to explain the most distant observations, but background-field-flow would be a much faster assembly process than dark matter via gravity.
2. Based upon our research, dark matter is not needed to explain spiral galaxy rotation profiles, and by implication, it is not needed to explain any other observation anomalies now attributed to dark matter. Non-baryonic dark matter probably does not exist at all, but if so not in the quantities needed to explain any gravitation anomalies.

3. Strong evidence supporting the FFV model is in its superior accuracy in spiral galaxies, which has been determined by statistical calculation to be very accurate. But maybe of equal importance are the observations by others of vast universe scale directional cluster flows having a strong statistical correlation between the directional flows of these large scale galactic structures, and the galactic rotational directions, axes of rotation, and the alignments of galaxies within the cluster. We believe these observations are strong evidence for the reality of background field flows, and evidentiary support for the FFV model [2]. The related link below concerning galaxy cluster flow is the most often cited research in this paper. https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3https://www.mnn.com/earth-matters/space/stories/something-mysterious-syncing-movements-galaxies-across-universe [3]

4. According to the FFV model astronomers and theorists alike are using the wrong model of the universe and related equations to explain the motions of galaxies and of the universe as a whole by only using Einstein's Cosmological Equations. Instead, background-field flows herein proposed, would be a substantial competitor to gravity in explaining the form and motions of the universe. Upon this realization, equations for field-flow at the galaxy cluster level could likely be combined with gravity equations, as done in this study for spiral galaxies, to test the large-scale field flow hypothesis concerning spiral galaxies. Our expectations are that a far more accurate mathematical model of the universe can be created with an addendum to Einstein's field equations, but expectedly separate from gravity equations as in our spiral galaxy vortex model and equations.

5. It is seldom discussed that the effects of increased gravity do not increase velocities within spiral galaxies or galaxy clusters. Gravity can only control pre-existing velocities and slow matter down. For increased velocities, additional forces or momentum are required in the first place and assumed based upon matter interacting with each other mostly during galaxy formation. If not then why haven't some spiral, irregular, and elliptical galaxies that may have had comparatively little formation momentum collapsed into primarily central galactic black holes instead of maintaining their spiral or another form for tens of billions of years? If there are

internal field flows within these galaxies, as in the FFV model, then such flows would work contrary to the gravitational collapse of galaxies and clusters, as well as within the universe as a whole better explaining the forms and motions of the universe as we now observe them.

6. Based upon our study and related hypothesis, field flow has the form of a vortex within spiral galaxies. We have laboratory evidence for the existence of the Zero-Point-Field (ZPF) [21] for more than 70 years now. We know that the Zero Point Field must orbit the galaxy like its stars and matter otherwise the cosmological principle would not apply to it, i.e. that the universe is spatially isotropic, at the largest scales generally looking the same in all directions, from all perspectives, for all galaxy clusters, stars, planets, and moons. When the ZPF orbits the galaxy, it must be gravity-centered like matter for the cosmological principle to apply. If the ZPF is gravity-centered, could its forces also be directed toward the galactic center as gravity? Could its internal energies have the energy of relative motion involving energy absorption by matter to some extent? If so then its energy density would be greater at galactic exteriors resulting in physical field flow, and/ or energy flow inward, from higher background field densities and pressures to lower densities within galaxies, and their cores would also involve tangential and inward pushing vectors. Field flow velocities would accordingly be at their greatest at galactic exteriors, and at their least at galactic centers. There is no lack of background field theories. The long-known field of virtual particles is called the Zero Point Field, ZPF, and ZPE. Today's new proposals are the Higgs field, hypothetical dark matter, dark energy, and more speculative proposals such as gravitons, quantum foam, etc. Other than the quantum substrate, few have yet proposed physical background flows to them other than following along with matter and gravity. Theoretical exceptions proposing background field flow have been the expansion of space and dark energy.

7. For spiral galaxies, the FFV model predicts velocity profiles of stars far better than any other model, to the extent that statistically, it's close to a certainty, which has been shown in the statistical calculations of this paper.

8. The FFV model shows statistically that only baryonic matter is needed to accurately predict spiral galaxy rotation profiles, and by implication, all other observation anomalies now attributed to dark matter alone.

9. At the largest scales of the universe, background field flows would be both curved and linear and generally be gravity-centered. Field flows would have a calculated mass equivalence that roughly would average 2/3rds the mass of the galaxy. And another roughly 1/3 of the total galactic mass and field-flow energy would be outside and between galaxies, and accordingly would contribute to the increased velocities of exterior matter being pushed toward these galaxies. Field-flow would greatly increase galactic velocities within a cluster over those velocities calculated solely based upon the observable matter, but field-flow accordingly would also cause galaxy and cluster formation at a much faster rate. Very-large-scale directional galactic flows have recently been observed that correlate with the angle of the galactic planes and the directional orientation of the galaxies within them [9]. The related question would be whether these observed field flows were caused by a flowing quantum substrate as herein proposed, or have another cause and reason for the observed correlations between cluster motions and the galaxies within them. https://iopscience.iop.org/article/10.3847/1538-4357/ab3fa3https://www.mnn.com/earth-matters/space/stories/something-mysterious-syncing-movements-galaxies-across-universe [12]

10. **Prediction:** The FFV model proposes to be able to calculate the total galactic mass needed for calculating a spiral galaxy's velocity profile based solely upon the observed galactic matter of its spiral disc and its rotation velocity, even if roughly only half the galactic matter can be observed. Instead, the observed rotation velocities of the galactic disc and the calculated velocities of the proposed background field vortex within it can accordingly determine the calculation and location of the unobserved mass. For this calculation, two set points are needed within the observed galactic disc.

11. A primary consideration concerning both the separation and complement between the gravitational mechanism and field flow mechanism being proposed *"is that the moving background field, sometimes called the quantum substrate (QS)) represents locally the ultimate reference (frame) for rest and for the motion of matter and fields. This is accomplished automatically if the QS is the substrate in, which all the elementary particles and fields are excited and in, which they propagate according to the rules dictated by quantum mechanics or move classically according to the principle of inertia*[1]." According to our proposal, both gravity and background-field-flow would often work in tandem directed towards centers of gravity.

12. The FFV model also predicts a far more rapid creation mechanism for both galaxies and galaxy clusters in the first place as a result of large-scale external field flows towards mutual centers of gravity. Our estimates propose that these, and all other large-scale structures of the universe, would be created many times faster than by the effects of gravity alone.

5.1 Summary and Questions

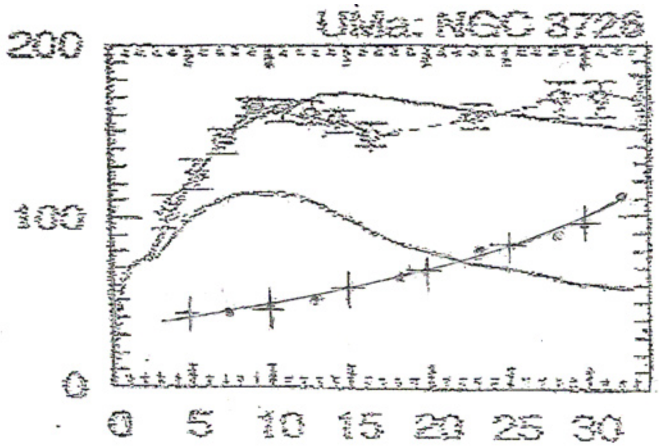
Dark matter is an unknown and so-far undiscovered entity. It requires that 84.5% of the matter in the universe is dark matter. Based upon this study, dark matter makes very poor predictions of spiral galaxy rotation profiles as well as making poor predictions at galaxy-cluster and universe scales when a method to verify its predictions is available. A background field was first proposed about 100 years ago and has continuously been observed for at least 70 years. Quantum fluctuations of a background field were the supposed source of the Big Bang beginning. The background field must flow with matter in the galaxy for the cosmological principle to apply. The FFV model requires less than one-fifth of the mass equivalence needed for the dark matter proposal. Besides following matter, the proposed background field must have its own flow energy toward the center of gravity. Other proposals of a flowing background field have been expanding space and dark energy. When comparing dark matter with the background field flow proposal, readers need to consider the most important factor, which is the far greater accuracy of the FFV model. Aside from accuracy, which proposal is more likely: A hypothetical field that requires five times more unknown matter than ordinary matter, or a proposal involving a known field with known matter (virtual particles), having a known stellar flow rate, but with a hypothetical pushing force via its flow toward the center of gravity? By far the most important factor in such a decision is the far greater accuracy of the FFV model concerning spiral galaxies, but additionally, we showed examples where dark matter cannot explain many observations at the galaxy cluster scale, as well as many failures of dark matter predictions at these same scales.

Epilogue

For the background field flow proposal to be considered more likely than dark matter or modified gravity, it will be necessary for others to conduct larger-scale studies to verify our findings. It would be expected that if studies continue to verify the FFV hypothesis, sufficient ongoing funding would be available for continuing research. If dark matter is the wrong hypothesis and if the background field flow hypothesis remains unknown, new studies looking for dark matter will continue to waste time, funding, and efforts looking in the wrong directions. Unfortunately, there will be resistance to the background field flow model since the Lambda Cold Dark matter model is supported by the dark matter hypothesis.

FINAL CALCULATIONS http://www.datalaundering.com/download/galaxies-ffv.pdf, as e.g., Galaxy NGC 3726 and others (NGC 3726, 5533, 4100, F 568-3, 6674, 6503, 2403, 6946, 2998, 2841, 3198x, 3893, 4088, 4138, 4157, 4183, 5033) might be found in the link above, which is illustrating the calculation of the equation

$$\mathbf{V_p} = (1 - (\mathbf{E}\text{mp}/\mathbf{E}\text{mt})) \cdot \mathbf{V}_{2\,\mathbf{max}}.$$



43,46,58,71,85,93,100 v_{2max}

This vortex decreases in velocity at a rate less than a fixed body vortex but at a greater rate than vortices that decrease slowly.
Galaxy NGC 3726

Each column for each row averages all the information between ± 0.5 kiloparsecs so that all the data of the complete radial distance will be included within the totals by general averaging.		Columns					
Rows	Rows follow the step by step calculation of equation (7), $\mathbf{V_p} = \left(1 - \left(\mathbf{E_{MPS}} / \mathbf{E_{MT}}\right)\right) \cdot \mathbf{v_{2\,max}}$						
		1.	**2.**	**3.**	**4.**	**5.**	**6.**
1.	Distances in Kpc						
2.	Scaled velocities from galaxy velocity profile						
3.	The square of the Newtonian velocities as indicated above, curve A, $\mathbf{V}^2$	10	12,1	9,025	7,225	3,025	2,5
		5	10	15	20	25	30
	The Newtonian velocities squared, row 3, times the distances from the center of galaxy, row 1, equation (2).	25	121	135,4	144,5	75,625	75
4.	$\mathbf{V}^2 \cdot \mathbf{r}$ times 5 divided by 2						
	The sum of the mass equivalence, line 3, from right to left.			430,5			

5.	Set point 15 kpc	576,50	551,50	set point	295,13	150,63	75
	Row 5 divided by the total mass equivalence	0,569	0,544	0,425	0,292	0,149	0,074
6.	TM <u>1,012,941</u>					160-60	= 100
7.	$\left(1-\left(\mathbf{E}_{\mathbf{MPS}}/\mathbf{E}_{\mathbf{MT}}\right)\right)$	0,431	0,456	0,575	0,708	0,851	0,926
8.	The $\mathbf{E}_{\mathbf{MPS}}/\mathbf{E}_{\mathbf{MT}}$ ratio times the Value 100 km/sec of $\mathbf{v}_{2\,\mathbf{max}}$. This fully calculates the vortex velocities of equation 7. These results are the plotting points of the vortex velocity curve C	43	46	58	71	85	93
		Vortex velocities above in km/sec					

Project Funding was by the Pantheory Research Organization's members, a California, USA, non-profit research Foundation.

Responses:

All readers are encouraged to ask questions they might have regarding this paper or the related study. The authors will be happy to answer any questions as well as consider comments and corrections. We will provide additional information as requested by e-mail, regarding the derivation and use of our equations and working examples.

Availability of data and material:

Upon e-mail request by any reader, we can send all the graphs and calculations for all of the spiral galaxy velocity profiles shown and calculated for this paper. We can also e-mail a number of additional pages of our research concerning observations and theory contrary to dark matter.

A press release explaining this research can be seen here: https://www.heraldmailmedia.com/news/nation/dark-matter-probably-does-not-exist-was-a-major-conclusion-of-an-extensive-research-study/article_eb3b08e7-a34c-5ffb-a6cb-752870828e5b.html

We expect to be able to provide help for all those interested in testing these equations, have new or different insights, or need additional explanations. We will be happy to discuss any-and-all aspects of this paper and/or its relationship with related papers the authors have published.

Please Contact **Forrest Noble at <u>pantheory.org@gmail.com</u>, or phone (562) 331-8334 or (562) 924-3313 in the U.S.A. for all questions, corrections, response requests, etc.**

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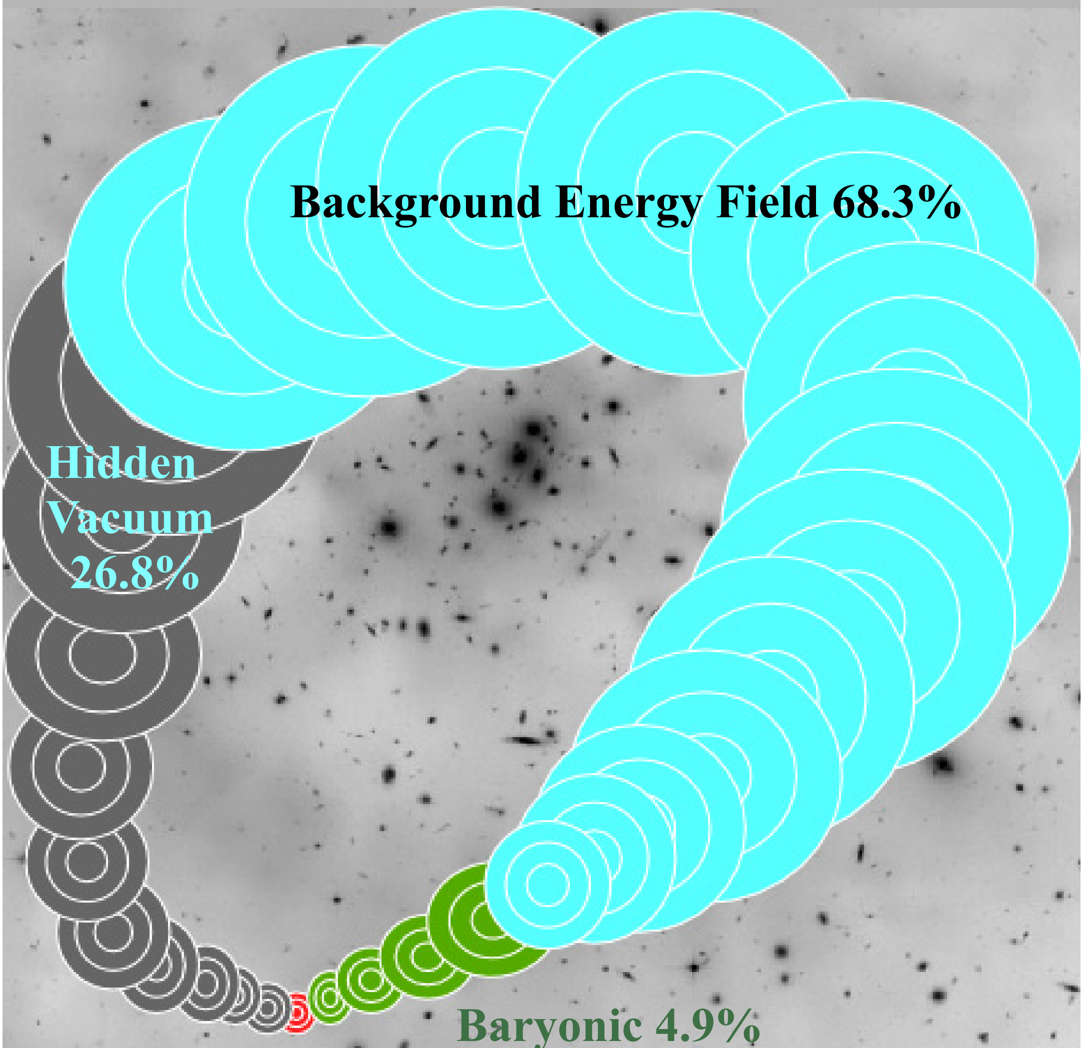

The Puzzle of Planck Mission

The image above appears to relate to the findings of the Planck mission, a space observatory operated by the European Space Agency (ESA) from 2009 to 2013. The mission's primary goal was to map the Cosmic Microwave Background (CMB) radiation.

In the image, the composition of the universe is broken down into three components:

1. **Background Energy Field (68.3%)**: This likely represents dark energy, the mysterious force driving the accelerated expansion of the universe.
2. **Hidden Vacuum (26.8%) or Vacuum Glue**: This term seems to correspond to dark matter, the invisible matter that neither emits, absorbs, nor reflects light, but whose presence is inferred from gravitational effects on visible matter.
3. **Baryonic Matter (4.9%)**: This refers to ordinary matter, including stars, planets, and all known elements.

The image uses a series of circles or rings to visually depict these proportions, emphasizing the overwhelming dominance of dark energy and dark matter in the cosmos. The background features cosmic elements, reinforcing the astronomical focus of the Planck mission. The title "The Puzzle of Planck Mission" suggests that the image addresses the mysterious and not fully understood components of the universe that the mission has helped to elucidate.

HUBBLE-INDEPENDENT PROCEDURE CALCULATING DISTANCES TO COSMOLOGICAL OBJECTS

J. E. Mullat *

Abstract. We offer a theoretical explanation for the data obtained by the Planck satellite, grounded in the absorption coefficient of the Beer-Lambert law and guided by the foundational principles of Pushing Gravity. Our experiment investigates the composition of the Universe through the hypothetical postulate of a Background Energy-Field phase transition. This framework allows us to establish the field energy absorption scale, which serves as the basis for making predictions about the dynamics of the Universe's matter composition, both in the past and the future. We developed a novel procedure for calculating distances to galaxies without relying on Hubble's constant. This method was then compared with traditional approaches, including luminosity distances, the Hubble's law diagram, and an alternative method based on redshift-dependent linear calculations. For comparative analysis, we sourced luminosity and Hubble's law distances from the NASA/IPAC Extragalactic Database (NED), managed by the Jet Propulsion Laboratory at the California Institute of Technology under a NASA contract. NED is a comprehensive catalog of extragalactic objects, offering cross-identifications of names, precise positions, redshifts, and a collection of basic data. Our results, however, challenge rather than support the predictions of the Standard Cosmological Model, offering an alternative perspective that aligns more closely with the theoretical implications of the Planck satellite experiment.

Keywords: *Universe Composition; Quantum Vacuum; Red Shift; Visible/Baryonic Matter; Background Energy-Field*

1. INTRODUCTION

> *As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality. Albert Einstein*

The essence of this story is that our Universe could have been formed from the absorption of so-called graviton particles, which can be considered a qualitatively new form of vector-field energy. The gravity of this field serves as the fundamental basis of the world, generating vacuum voids and various anti-vacuum elementary baryonic particles. This process leads to the continuous appearance and disappearance of gravitons, aligning with the classical conservation of energy (both potential and kinetic), viewed as the conservation of gravitons and their momentum, which remain upon absorption equivalent (e.g., electrons) to the absorption of a lump of gravitons. If the strength or tension of the graviton field exceeds a certain level Λ, gravitons can undergo a phase transition and transform into real particles.

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From this perspective, the entire Universe before the time zero point can be seen as being in a stationary yet highly excited energy state, much higher than the current one. This state, referred to as the energy-field, possessed immense but latent potential energy. Through a quantum leap, this energy-field transitioned into a less excited state—first into a quantum vacuum or glue, and eventually into baryonic matter—expending all its energy in the formation of the visible Universe. This quantum leap likely originated from a graviton vector-field, which has the capacity to create matter by imparting energy to it, consistent with the concept of graviton force.

At the zero point, the potential energy of the energy field was exceptionally high but decreased significantly after the transition. This transition at the zero point of the Universe triggered an explosive and rapid inflation, initiating a sudden and immense space capture. The rapid inflation fragmented the newly created space in a non-isotropic and nonhomogeneous manner. As a result, quantum voids of vacuum and baryonic matter formed, eventually leading to the creation of quasars, galactic clusters, jets, and fluxes. The extreme pace of inflation also caused the distant parts of the Universe to become completely disconnected, allowing each region to evolve independently. Some areas continued to expand indefinitely, albeit at a slower rate, while others began to pulsate or contract, re-entering a high-energy state and triggering new quantum transitions that generated additional galaxies.

During this inflation phase, the newly created space resembled the Big Bang but was fundamentally different: the matter that formed did not expand outward but remained at rest. Like raisins in dough, additional pockets of matter continuously appeared, gradually layering and creating new "dough." At the same time, as the radius of the matter-filled space increased, the energy loss of atoms within this "dough" accelerated. Consequently, the vacuum voids began to fill; the more the vacuum engaged in matter creation, the more external energy contributed to the formation of new matter. In this newly created space, the average absorption coefficient κ of graviton particles—adapted here from Danilatos's work (https://zenodo.org/doi/10.5281/zenodo.3596184, accessed 30.07.2024)—decreased due to the energy loss by atoms, even though the overall energy within this matter-filled space continued to accumulate.

The quantum transition of energy vector-field absorption into matter can be explained by assuming that matter initially formed with large atomic distances within atoms. In this early stage, the electrons that contributed to nucleus formation orbited the nucleus from a distant, weaker position, making them easier to remove with minimal energy loss. As a result, the dynamics of electromagnetic energy emitted by atoms can be described using quantum mechanical formulas, with the assumption that the initial energy release was small and gradually increased as new spatial voids were filled. Consequently, light waves from the distant past would appear redshifted.

One may wonder how the quantum transition postulate fits galaxies having spectroscopic blue-shifted lines, such as the Andromeda galaxy. Is the light from Andromeda coming from the future? This paradox from the expanding perspective can be explained by the fact that astronomers cannot observe the effect of quantum transition (space expanding) in neighboring galaxies. Instead, they observe the relativistic Doppler effect, which dominates the transition (space capture) effect. This explanation of the redshift/blueshift indicates the dual nature, cf. Gupta (2018), of the parameter 1+z. Most astronomers believe that the Doppler effect is the correct answer because they observe galaxies in the neighborhood. However, a few others rightly emphasize that the Doppler effect is not the correct answer for cosmological objects located far away, which have high cosmological redshift values.

It is also known that primary heterogeneities during the phase transition from one form of matter to another can sometimes lead to secondary heterogeneities in the newly formed matter. Therefore, we might consider the intriguing hypothesis of the graviton transition in matter

(Caldwell et al., 2005) and adopt the postulate of newly created particles of matter, which could be associated with different intrinsic redshifts within the same atoms formed simultaneously. This could support Halton Arp's (1966) assertion about the physical coexistence of cosmological objects with varying redshifts in close proximity, as observed in Arp's peculiar galaxies.

In the novel titled "Γ-Equation Distance Calculation," we explore a hypothesis involving the graviton transition of the energy vector-field absorption into quantum vacuum and baryonic matter. For this calculation, we use a coefficient κ representing the average energy absorption of space, which, under this hypothesis, must constantly decrease. The capital parameter Λ serves as a threshold, indicating when the gravitational vector-field's potential energy is strong enough to initiate the absorption process, while the small parameter λ acts as a tuning mechanism. Gravitational potential energy is a scalar physical quantity capable of performing work. Within this framework, we implement the Γ-equation to highlight the dynamic nature of space in the Universe, calculating distance estimates to cosmological objects where the space-layering postulate is a fundamental element.

Modern cosmology is undoubtedly undergoing a significant transformation, as many renowned scientists are re-evaluating the general theory of relativity concerning space and time (Jones & Lambourne 2004; Copeland, Sami & Tsujikawa 2006; Gradenwitz 2018). This departure from the Standard Model (SM) and the widely accepted view of the Universe's origin is driven by the realization that theoretical predictions based on universal gravitation laws do not align with large-scale observations, particularly at cosmological distances. For centuries, we've observed that the distant parts of the Universe, when viewed on a large scale, exhibit a homogeneous and isotropic structure. This principle, rooted in the Copernican principle of mediocrity, was a cornerstone of cosmology, supporting the idea that the Universe is homogeneous and isotropic, with parameters such as brightness appearing consistent across all points and in all directions. The newest discoveries by the James Webb Telescope cast, however, some doubts on this principle.

As noted by Larry Abbott (1988) regarding the Standard ΛCDM Model, and echoed by Bradley & Ostlie (2007) and Keel (2007), "According to theory, the constant that measures the energy of the vacuum should be much greater than it is. Understanding this discrepancy could revolutionize fundamental physics." Indeed, groundbreaking research by Adam Riess et al. (1998) and Saul Perlmutter et al. (1999) revealed that, contrary to expectations, gravity is not slowing down the space capture of the Universe but is actually accelerating it. This has led some researchers, including Lerner, Falomo & Scarpa (2014) and Lerner (2018), to argue that observations do not support the standard expansion theory, while others, such as J.G. von Brzeski (2018), seek to disprove the expansion theory altogether.

Although our goal is not to challenge these conflicting views, this study examines the evolution of the Universe from an "space capture/growth" perspective. In contrast to the SM, our approach postulates that growth occurs simultaneously with the disappearance of energy-field regions due to the creation of new static space, which, in turn, experiences a decrease in energy absorption. Our research suggests that this growth of newly created static space is manifested first through the quantum vacuum or "glue," followed by baryonic matter, both undergoing a graviton transition from an unknown energy vector-field—often referred to as the zero-point field, quantum foam, or gravitons—into a new spatial composition of expanding three-dimensional spheres, or manifolds. We hypothesize that a new space emerges as soon as a stable state in the previous space composition is established, since the old space violates the Γ-equation stable state criterion (cf. Mullat 1995, definition 2, p. 212). Based on this premise, the previous stable state inherently destabilizes, leading to the creation of "new space." This newly created space—a manifold in space—on average, achieves a lower "density of absorption" compared to the previous state. This violation is attributed to latent "graviton energy forces" or other forms of energy that induce changes within the manifold, providing a theoretical basis for the evolution of stable states as determined by the dynamics of the Γ-equation's roots.

Consequently, according to the postulate of space layering, the declining indicator of energy absorption per unit mass (real or effective, cf. Danilatos) not only marks the creation of new space but also suggests a replacement for the time scale component of the space-time metric tensor—typically defined by the parameter—with t. While this is a radical and unconventional assumption, it introduces a more diverse perspective on the dynamics of space and energy evolution in the Universe. Under this assumption, the time variable in the space-time tensor will be omitted from all subsequent considerations.

According to NASA's statement about the acceleration of the visible Universe, for any observer located at any point in the Universe and at any time in the past, the growth was slower than it is today. This statement invisibly hides the fact that the solutions of the Γ-equation do not contradict NASA's predictions about the dynamics of the universe in general. Yet, the math shows that the Hubble constant is not a constant at all. In the past, perhaps, the value of the Hubble constant was much lower than it is now, and it will be increasing in the future.

The question arises: does what astronomers call dark matter (hereinafter—the quantum vacuum or something else—vacuum or matter) explain the contradictory characteristic features of the dynamics of baryonic matter? Does such a Hubble constant refer to a quantum vacuum? Making this supposition, we found that, in the death phase, when the energy vector-field of the Universe will be almost exhausted, the dynamics of the quantum vacuum, in terms of the Vacuum Hubble Constant, will change its nature—the acceleration of the quantum vacuum area size will slow down. In contrast, the baryonic matter will still continue to expand its occupied area with acceleration, growing as usual in area extent and dimension, like a window or bubble amid the energy vector-field.

It was simple to calibrate the Γ-equation of quantum vacuum and baryonic matter, as well as the energy-field composition manifested by the equation, in order to match the 2013 Planck Mission satellite data. By solving the Γ-equation, it was possible to achieve 100% exact co-occurrence between the obtained percentages of baryonic matter and quantum vacuum (dark matter or vacuum glue) in their proportions to the background energy vector-field and the latest data (Ade et al. 2013; Francis 2013; Clavin 2015).

Second, our space/energy graviton transition model supported the Big Bang inflation phase. Theoretical foundations show that solely the quantum vacuum, as discussed by Tentanen (2019), first inflated three-dimensional manifolds embedded in the globe $\mathfrak{R}^4$. Third, it is predicted that after the inflation phase, as the manifolds S^3 captured new space, their energy absorbtion κ decreased while volume growth accelerated. This prediction was supported by the Γ-equation, the roots of which confirm that the manifolds initially expanded more slowly when the energy absorbtion was high. Drawing upon the study pertaining to the average density of absorbtion coefficient κ, it was possible to subject NED distances to a series of linear and non-linear transformations into a certain interval of absorbtion densities. This interval confirmed with a very high degree of reliability that it is feasible to describe the events in space with κ by establishing a match to a number of distances to extra-galactic objects collected in the NED database [1].

We further posited a critical value κ of the density at which the *graviton/energy vector-field* will be exhausted. We denote this event as the origin of the density scale, i.e., the "*moment*" when the globe $\mathfrak{R}^4$ would allegedly collapse into a "*standstill*" composition with a absorbtion critical level state. The Standard Cosmological Model also supports a very high likelihood of such an event. We also confirmed some of NASA's statements regarding the past evolution of the Universe.

Before we proceed with our analysis, we wish to outline the structure of this study, which is divided into eight sections, including the Introduction (Section 1). Section 2 provides helpful insights into the mathematical foundation of our technique. As an initial exercise, we present the stereographic mapping of a two-dimensional surface $\boldsymbol{S}^2$ of a three-dimensional ball $\boldsymbol{\mathcal{R}}^3$ onto an Euclidean plane $\mathcal{E}^2$, perpendicular to the

[1] https://ned.ipac.caltech.edu/classic/forms/byname.html (accessed 29.06.2018).

axis connecting the North Pole $\mathrm{N} = (0,0,+1)$ and the South Pole $\mathrm{S} = (0,0,-1)$ of the sphere. In Section 3, this stereographic mapping is generalized to a four-dimensional manifold $\mathcal{R}^4$, where the three-dimensional surface S^3 of the manifold $\mathcal{R}^4$ becomes the image of the stereographic mapping, resulting in the three-dimensional Euclidean manifold $\mathcal{E}^3$, analogous to the axis connecting the North Pole $\mathrm{N} = (0,0,0,+1)$ and the South Pole $\mathrm{S} = (0,0,0,-1)$. We provide preliminary exercises by describing a hypothetical energy field undergoing a graviton transition into quantum vacuum and baryonic matter based on our geometric model. By applying the postulate of the graviton transition of the energy field at distances approaching the Planck wall (Section 4), the subsequent growth of space is a result of the postulate associated with a triplet of scalar parameters (Λ, λ and absorption coefficient κ) as expressed in the form of the Γ-equation.

In Section 4, we continue by focusing on the construction of the energy absorption scale, which is achieved by fine-tuning or calibrating the triplet of parameters (κ, Λ, λ) with respect to the current mass-energy composition of the Universe. Here, the mathematical derivation of the Landau-Lifshitz metric space is presented in the form of a stereographic projection. In Section 5—The Results—we consolidate the roots of the Γ-equation with data from cosmological observations of 15,000 extraterrestrial objects, collected in the NED data2 (Table 2-4) and Figure 5, which present a summary of the data analysis. Following the discussion in Section 6, concluding remarks are provided in Section 7.

In Section 8, we present the mathematical derivation of the three-dimensional series of manifolds S^3, which, according to our initial hypothesis, are expanded with space. In conclusion of this section, we present the results of calculations on the partition of our three-dimensional Euclidean surface, S^3, of the $\mathcal{R}^4$ manifold into three regions that correspond precisely to the distribution of visible matter, dark matter, and what cosmologists today refer to as dark energy, according to the 2013 Planck mission satellite data: **4.9%** visible (or baryonic) matter, **26.8%** dark matter, and **68.3%** dark energy.

We illustrate the graviton energy-field transition in the Appendix by presenting our stereographic projection of the S^3 series of manifolds into Euclidean static space $\mathcal{E}^3$. It should be noted that our model supports, rather than contradicts, NASA's statements on the dynamics of the Universe, which are based on past and current observations. In conclusion, we should mention that part of the material in our study, including Figure 1 and all the conclusions in the Appendix that led to our theoretical Γ-equation (which, according to our mathematical derivation, corresponds exactly to the metric of space), is not widely known in the literature (see §108, p.336, "Classical Theory of Fields," Landau & Lifshitz, 1971, English edition) and has already been published in the public domain.

2. Preliminaries

Suppose we pointed our "telescope," or whatever we can imagine, toward a portion of the three-dimensional sky on which we superimposed a grid of gravitons. By analyzing the characteristics of the light rays reaching us, we would allegedly be able to estimate the number of photons, electrons, and atoms of various types of matter, including galaxies, at the moments when the rays were emitted. Once the process is complete, we can focus the same efforts of our cognition on another part of the sky. Despite the validity or invalidity of the Copernican's homogeneous principle, we can expect to obtain similar results due to the isotropy of observations when observing parts of the Universe at the same distance from our observation point in any direction.

When idealizing the Copernican Principle, all points in the Universe are considered equivalent in all directions, with no central point or terminal end. However, contemporary cosmology suggests that the Universe may not fully adhere to the Copernican Principle. While the principle posits a homogeneous and isotropic space, characterized by a uniform distribution of galaxies at every point and in all directions, it also recognizes the universality of the laws of physics. These laws apply consistently throughout the Universe with the same precision, since there is no preferred point of reference, even though any point within the Universe could theoretically serve as one.

Such measurements will be particularly useful when the observations made are incompatible with Newtonian dynamics—i.e., measurements at cosmological distances. In this scenario, the key challenge is to compare the energy densities of space at nearby and faraway distances as indicators of the layering dynamics of space and matter in the Universe. These measurements at cosmological distances can describe events by the average energy absorption coefficient (κ), using the reciprocal relationships of events on this scale.

By analogy with the Copernican postulate, consider the following illustration from a layman's perspective. Imagine watching a perfectly homogeneous sheet of paper, uniform in all directions, burn. If you ignite the sheet somewhere near the center, the fire will gradually spread outward, consuming new areas and turning them into ash. Since the sheet is homogeneous, this outward spread occurs symmetrically, with no preferred direction of burn. By observing the ash during this process, it is possible to measure the temperature of the gradually cooling remains. Based on this measurement, we can infer how far certain regions of the ash are from the observer, knowing that the burning progresses uniformly across the paper, much like the isotropy implied in the Copernican principle.

Another useful analogy involves radioactive decay. On Earth, nuclear physicists determine the age of a material by counting the average number of atoms that have undergone radioactive decay. For example, geologists can determine the age of a rock by observing unstable atoms decaying, calculating the half-life of the remaining atoms, and comparing different samples. Now, imagine that instead of counting the average number of decayed atoms, we could precisely count every single atom of a specific isotope, such as a tin isotope, within a rock. Furthermore, suppose we could do this with extreme accuracy, accounting for every atom that remains after decay. While such an experiment may be beyond our current capabilities, it is possible to estimate the remaining number of atoms after decay as quasi-events, which could be used to approximate the age of the rock.

By examining various parameters of the rock, such as its size and temperature, we can also estimate the "quasi-velocity" of these parameters, by counting the number of atoms that have not yet decayed. In a similar way, we can determine quasi-events in the universe—events that reflect cosmic processes—without relying on a traditional clock.

Returning to the earlier discussion on the observation of different parts of the Universe, we can also assume that the energy absorption coefficient (κ) of various particles (photons, electrons, neutrinos, galaxies, etc.), determined by observing a nearby grid of space, differs from that observed at greater distances. We now assert that, at closer distances, the matter density in the spatial grid is lower when superimposed on parts of the Universe at farther distances, representing their state at some point in the past. This assumption aligns with Hubble's law rather than contradicting it.

Thus, we can infer the temporal dynamics of the Universe by analyzing energy densities through the absorption coefficient in these two locations. Regions with lower energy absorption (at nearby distances) have emerged during later stages of matter creation than regions characterized by greater density (at farther distances). Consequently, we aim to highlight that the energy absorption coefficient (κ) can serve as an indicator of such events in static space. This approach allows for the establishment of the origin of time, where density indicates the zero-time point, $t = 0$, when $\kappa = \infty$. Similarly, it becomes possible to trace both the future and the past on this absorption scale, thereby investigating the evolution of the Universe in terms of the energy absorption coefficient (κ) rather than by using a conventional time scale.

Matter exists in four fundamental states—solid, liquid, gas, and plasma—and can undergo a phase transition from one state to another. At normal atmospheric pressure, water is in a solid state (ice) at temperatures below 0°C, where the liquid state symmetry transforms into crystal symmetry. Notably, a liquid can be cooled below its freezing point (known as supercooling) without becoming solid. Thus, when undergoing a phase transition to ice, water cooled below 0°C can release latent heat (Murphy & Koop, 2005).

This concept can be extended to hypothesize about "graviton energy" or matter supercooled below absolute zero (0 K). This line of reasoning might lead to the conclusion that, in the Universe, a graviton transition of supercooled "graviton field" into space occurred, releasing a substantial amount of latent heat. The space released by this transition expands; however, elsewhere on the globe, a latent graviton/energy-field transition might take place simultaneously.

Three-dimensional coordinates can be used to measure the ice floe linearly. However, the volume of water is typically expressed in liters rather than cubic meters. For creatures in the form of ice crystals, the water undergoing a phase transition is supposedly invisible, as they can neither observe nor measure phenomena related to liquid matter. They can, however, feel the effects of latent heat or space creation.

From a mathematical perspective, energy forms such as the quantum vacuum or the graviton vector field can undergo a transition from a zero to a positive measure state. This concept is deeply rooted in probability theory, where a probability measure is used to assign a numerical value to every space volume. This approach allows for the examination of the union of these volumes as the sum of their individual measures. An example of such a measure can be found in the space or mass of matter.

It is apt to recall Einstein's (1916) analogy of a two-dimensional surface for flat creatures, which implies that such creatures cannot conceive of a three-dimensional world while confined to the flat surface of a manifold. This analogy suggests that we, as three-dimensional beings, "inhabit" a three-dimensional static space. In this space, we perceive a three-dimensional unbounded Euclidean space $\mathscr{E}^3$ within a bounded manifold $S^3(r)$ of radius r, embedded in a four-dimensional closed hypersphere $\Re^4$ with a curvature radius of 1. Idealizing the Copernican Principle, all points on this manifold are equivalent in all directions, with no center or terminal point.

However, our understanding also considers deviations from the Copernic's Principle, as shown by Zeldovich, Einasto, & Shandarin (1982). These deviations are expected, as the Principle, in its absolute form, can never be fully realized in nature. Indeed, it is well established that primary anomalies in materials undergoing phase transitions—or in our case, graviton transitions—can lead to secondary anomalies following these transitional phases.

In the theory of choice, topology, and some branches of social science, the emphasis is placed on the so-called Closer Operator, as discussed by Pfaltz (2015). In this context, the Closer Operator is represented by the constant Λ in the Γ-equation, which ensures the dynamics of new space creation. The constant Λ signifies the fixed-point stability of layering manifolds S^3, representing a gravitational vector-field potential energy level of the expected graviton transition and the manifestation of the energy-vector field.

The introduction of the Closer Operator in mathematics presents a novel idea in explaining the origin of the Universe. By employing the constant Λ, the theory suggests a mechanism for space creation and stability within the Universe's structure. This approach aligns with the broader understanding of the Universe's dynamics, incorporating both the traditional principles of cosmology and the emerging theories of energy transitions and manifold stability.

To be more specific, our three-dimensional manifold with curvature radius R — which we denote as a closed topology, i.e., a manifold S^3 — consists of a type of energy vector-field that is not accessible to existing measuring instruments (similar to how crystal creatures cannot use liquid measurement system in their solid world). Due to some accidental event, at a specific point within S^3, an energy-field graviton transition occurs, forming a seed lump of another form of space. This transition represents a change from a zero-measure to a positive measure.

We emphasize that the lump of space formed from the potential energy-field embedding the lump must maintain stable or fixed-point dynamics while undergoing rapid inflation from zero and continuing to expand. This process is akin to a hole growing within the energy field, as discussed by Linde (1983a, 1984b). In essence, the lump of space must be in a dynamic Γ-equation with the energy field. The Γ-equation perspective on space dynamics offers an alternative to the Standard Model (SM), where the manifold curvature radius R is time-dependent. In contrast, the curvature $R = 1$ considered here is constant.

By making this assumption, we do not violate any mathematical foundations and do not challenge the postulates of rational science. Our goal is to provide an alternative to the SM to offer a reasonable interpretation of the paradoxes observed in astronomical phenomena.

The space creation singularity problem—specifically, the initial inflation phase described by Guth (1997) in the context of the Big Bang—remains unresolved. We propose that the singularity does not exist because our Γ-equation allows for a zero solution. We postulate that starting from a state described by this zero solution, space suddenly inflates from an infinitesimally small "seed" of quantum vacuum during the graviton transition into static space from the energy field. This seed might be no larger than a Planck scale.

According to this view, when a "*lump of space*" emerges, it exerts additional pressure on the previously "super-cooled graviton energy," causing further inflation. We assume that this process would lead to additional space creation, similar to an "*avalanche*" gaining mass and momentum as it rolls down a hill due to the potential energy of the super-cooled graviton field.

Our Γ-equation stipulates that the avalanche of space creation must remain dynamically stable. This assumption implies that the graviton transition of the energy field into the quantum vacuum starts suddenly and continues to progress if the super-cooled energy has a high absorption capacity. Once the avalanche has occurred, it governs the space creation within the manifold. However, just as a fragile snowball cannot roll down a slope indefinitely without breaking apart, this space creation process is finite.

While the snow-globe dynamic serves as a simplistic analogy to illustrate space evolution, it effectively represents both the initial and terminal states of this process. This layman-physics illustration underscores the idea that while the process of space creation can be dynamic and expansive, it is ultimately governed by inherent stability constraints.

3. The Model

In the continuation of our narrative, we combine some points to talk about the essence of the graviton transition model in our understanding. Apparently, the reader could more smoothly follow our cosmological apparatus, which prompted us to more accurately disclose details that may remain intellectual speculations unless something similar does not reveal itself as a reality. In science, it is important, in which direction to move, so as not to be at an impasse. Mathematically, everything is in order here, since we will have rich computational capabilities and will be able to formulate a sufficient number of non-trivial predictions.

3.1 Pedagogical preface

Consider a field W of high-energy environment consisting of 5 cells $W = \{\alpha_1, \alpha_2, ..., \alpha_5\}$ or gravitons. There is no need to refer to these main ingredients $W = \{-5, -1, -1, -5, -1\}$ in any other way than, for example, to gravitons, particles, etc. Negative numbers conceal a latent energy or status of gravitons indicating that the high energy-field graviton transition of the gravitons into space is conceivably available. Positive values will indicate the fact of the graviton transition into matter. Using these 5 gravitons, one can arrange subsetss or lumps of gravitons where the process of transition completed, for example, 4 of which will be $X_{5,1} = \{5,1\}$, $X_{1,1,5} = \{1,1,5\}$, $X_1 = \{1\}$, $X_{5,5} = \{5,5\}$, etc. So, $|X_{5,1}| = 2$ gravitons, in $|X_{1,1,5}| = 3$ gravitons, $|X_1| = 1$ graviton, $|X_{5,5}| = 2$ gravitons.

Let's talk about, e.g., some high-energy vector field indicators $\pi(\alpha_i \in X) = \alpha_i \cdot |X|^{-1}$ of gravitons probable transition into lumps X of space in the form of vacuum and baryonic matter. Numerical values $\pi(\alpha \in X)$ are defined within indicated lumps X. The negative index $u = \pi(\alpha \in X)$, as a parameter in the form of threshold u may indicate enormous energy level when the latent energy is turning into positive value by supposition. In particular, $u = -\frac{1}{3}$ will indicate soon some phase transition constant, e.g., graviton potential energy force or pressure, temperature threshold etc. Negative index indicates that transition is possible but latent. Positive values will point at inverse situation – transition is probably available. So, the probable graviton transitions events with our high-energy gravitons may arrange the following lists: $\{\pi(\alpha_i \in X_{5,1}\} = \{-\frac{5}{2}, -\frac{1}{2}\}$, $\{\pi(\alpha_i \in X_{1,1,5}\} = \{-\frac{1}{3}, -\frac{1}{3}, -\frac{5}{3}\}$, $\{\pi(\alpha_i \in X_1\} = \{-\frac{1}{1}\}$, $\{\pi(\alpha_i \in X_{5,5}\} = \{-\frac{5}{2}, -\frac{5}{2}\}$, $\{\pi(\alpha_i \in X_{1,1,1}\} = \{-\frac{1}{3}, -\frac{1}{3}, -\frac{1}{3}\}$.

On each X, given the list $\{\pi(\alpha \in X)\}$, we consider the value $F(X) = \min_{\alpha \in X} \pi(\alpha \in X)$. It turns out that $F(X_{5,1}) = -\frac{5}{2}$, $F(X_{1,1,5}) = -\frac{5}{3}$, $F(X_1) = -\frac{1}{1}$, $F(X_{5,5}) = -\frac{5}{2}$ and $F(X_{1,1,1}) = -\frac{1}{3}$. In standard notation we can consider a kernel lump X^*, which satisfy a condition: $X^* = \arg\max_{X \subset W} F(X)$, where the lump X^* deliver the function $F(X^*)$ global maximum – the **max/min** problem.

Until now we have considered only 4 lumps. What if we look at a space bubble W or sphere of gravitons in the form of a 3-dimentional room, which e.g., consists of a 10^{215} gravitons. Then the number of gravitons' transition lumps $X \subseteq W$ under consideration will be equal to $2^{10^{215}}$. Now our task at first glance will be *mission impossible* to find a kernel among all such a lump on which the minimum of the function $F(X)$ is reached. However, the problem is solved simply.

Let us illustrate the solution on the example of our 5 gravitons $W = \{-5, -1, -1, -5, -1\}$. First, we need to arrange gravitons energy field $W = \{-5, -1, -1, -5, -1\}$ in descending order of α-numbers in brackets $\{...\}$ in the increasing order $\langle W \rangle = \langle -1, -1, -1, -5, -5, \rangle$. Then we will move along $\langle W \rangle$ from the left to right, examining the gravitons while moving along the arranged list of lumps X_1, $X_{1,1}$, $X_{1,1,1}$, $X_{1,1,1,5}$, $X_{1,1,1,5,5}$. We attach the gravitons one by one to each lump in the sequence, keeping in mind that the attached gravitons are undergoing a phase transition, until we fill in the whole lump $\langle W \rangle$. Consequentially, while moving to the right, the gravitation potential (or latent) energy field indicators $F(X_1)$, $F(X_{1,1})$, $F(X_{1,1,1})$, $F(X_{1,1,1,5})$, $F(X_{1,1,1,5,5})$ corresponding to the sequence $\langle -\frac{1}{1}, -\frac{1}{2}, -\frac{1}{3}, -\frac{5}{4}, -\frac{5}{5} \rangle$ are considered. The local maximum $u^* = -\frac{1}{3}$ is reached on the lump $X_{1,1,1}$, which might represent phase transition into space only one lump of gravitons' among all the 32 lumps. It is obvious now that exactly the same algorithm among all the lumps in the bubble W of the size equal to $2^{10^{215}}$ works "*perfectly*".

Without prejudice to what has been said, looking ahead, we would like to note that in our cosmological model reg. distances $r(X)$ calculations to galaxies there are similar functions $\{-\pi(\alpha \in X)\}$, i.e., functions that increase (as negative) in accord of X growth: for example, the gravitational potential energy function propotional to $-\frac{|X| \approx \text{mass}}{r(X)}$. The X is an interior set while $\overline{X}$ is the outside set: $X \cup \overline{X} = W$, $r(X)$ denotes the radius of X. The kernel X^*, where the function $F(X) = \min_{\alpha \in X} \pi(\alpha, X)$ reaches its maximum, in our pedagogical nomenclature, will once again, be the solution of gravitons phase transition, cf., Mullat 1971.

3.2 General considerations

So, let a certain field (e.g. Graviton energy-field) W be given in which the field folds can pass from one state to another. It does not make a difference at first what these states are. It is important that there are two states, two phases from which the high-energy gravitons W are lumped together. Each graviton can be in two states—matter and energy, i.e., the gravitons can transit from the energy to matter and back.

Since this view on the field W is taken for something real or reasonable, it is very natural to consider the set 2^W of all lumps or high-energy gravitons W in which the graviton transition can happen, and let them be lumps of gravitons acting as compositions $X \in 2^W$, $X \subseteq W$. Such an abstraction in the notation represents the most common standard in set theory.

However, not being an experienced high-energy physicist and having no idea how a high-energy graviton transition takes place, it can still be assumed that all gravitons $\alpha \in X$ represent a probuble transition from latent graviton energy states to a materialized state, while all those gravitons $\overline{\alpha} \notin X$ that are in a state of probable transition as some candidates are only labeled as such. The set $\overline{X} = \overline{\alpha} \notin X$ is the part of W unfilled by gravitons from X. Shortly speaking $X \cup \overline{X} = W$ or $\overline{X} = W \setminus X$.

Now we need to say a few words about what we are going to consider for the lumps of gravitons X. In theory of measure we consider some "*good*" lumps of gravitons that can be measured: such as having mass measured by weight in kg^1, volumes in m^3 or liquids in lt^1 or galloons of gas, energy absorbtion in $j\_s \text{ per } kg$, etc. The starting point of the theory of measure is the probability theory. We not accidentally talking about probability, since it is very natural to link the high-energy graviton transition of any graviton $\alpha \in W$ with the certain "*quantum probability*" $\pi(\alpha \in X)$ that the graviton transition will occur as a subject of quantum transition itself. Note that the probability estimates $\pi(\alpha \in X)$ may be defined on W but inside X. That is, we consider a set or a family of parametric functions $\{\pi(\alpha \in X) : X \subseteq W\}$ consisting of $2^{|W|}$ individual functions dependent on a parameter X in the form of a lump of gravitons in the aggregated high-energy medium of measurable gravitons W. It is possible that some kind of quantum effects can play a role here, since this is about probability.

Now, we reached the most important point. Suppose that in the aggregated high-energy-field W the gravitons are characterized by a certain distribution functions $f(\alpha)$, $\alpha \in W$, or whatever we want to interpret these functions. These functions may be some initial force acting in the graviton α like temperature, pressure, etc. We cannot imagine or say more, but the following phenomenon is important. For example, we can associate this function with some estimate (not with the probability but a graviton transition process itself), for example, by setting $\pi(\alpha \in X) = \frac{f(\alpha)}{|X|}$, where $|X|$ it is weight, lump volume, etc., which aggregate gravitons X. We can also supposedly associate this function with some threshold u when the graviton transition occurs. Such functions can be constructed in order to satisfy many conditions but one mandatory condition, which is characterized by the so-called monotonicity property. Indeed, suppose we consider two lumps of gravitons L, G such that $L \subseteq G$, then the following monotonicity property should hold: $\pi(\alpha \in L) \le \pi(\alpha \in G)$ for all $\alpha \in L$.

Finally, we meet the main assumption. Based on the proposed scheme for any set of gravitons $X \subseteq W$, we have a certain probability function on the anti-gravitons $\overline{\alpha} \notin X$ that are outside X of the indicated by using the function $\pi(\overline{\alpha} \notin X)$ of the probability of a graviton transition in an outside graviton $\overline{x}$. Suppose that the graviton transition is determined by a certain threshold value u of the function $\pi(\overline{\alpha} \notin X)$, namely: in the set X the graviton transition can take place only if $\pi(\overline{\alpha} \notin X) \ge u$, while for $\overline{\alpha}$ out of X, it can be $\pi(\overline{\alpha} \notin X) \ge u$ either $\pi(\overline{\alpha} \notin X) \le u$, in the latter case the transition cannot take place. A similar view on graviton transitions gives rise to the display of lumps in two equivalent aggregate lumps of gravitons W:

$$V_u(X) = \{\alpha \in W | \pi(\alpha \in X) \ge u\}, \text{ or } V_u(X) = \{\alpha \in W | -\pi(\alpha \in X) \le -u\}.$$

In theories, speaking of mappings, we always are interested in the so-called fixed points, (i.e., fixed point theorem of Brauwer). In our case, we will also be interested in fixed points of mapping $V(X)$, i.e., such lumps X of gravitons of the field: $V_u(X) = X$. $\Leftarrow$ Γ-equation.

Given lumps sequence $X_0, X_1, \ldots X_i, \ldots$ such that $V_u(X) = \lim_{i\to\infty} X_i$, $X = X_0$. $X_0 \subset X_1 \subset, \ldots$ it is simple to figure out what these fixed points $V_u(X)$ of mappings are. Perhaps $V_u(X)$ is a state of space of the high-energy, or fixed point of the vector-field when the graviton phase transition process stopped, etc. We claim that Γ-equation in our cosmological model devoted to distances calculation to galaxies corresponds to such a fixed point in terms we just have been described. For some researches this terminology in choice theory represents so called closer operator $V_u(X)$ performed on X.

3.3 Prospects

In our findings when calculating of the distances to galaxies we will be able to define the vector-field W in the framework of PG principles operating at any distance as a diverse surface, or as a three dimensional manifold $\boldsymbol{S}^3(\mathrm{r})$ of radius r embedding the four dimensional globe $\mathcal{R}^4$. Monotone System Functions $\pi(\alpha \in X)$ of the gravitons α will be chosen depending on tension or intensity of the gravitons vector-field (following the PG vector-field framework in accord to Danilatos, 2024; https://zenodo.org/doi/10.5281/zenodo.3596184, equation 26) in the form of

$$-\left(\frac{\kappa}{\mu}\right)\cdot\frac{M}{r}, \text{ where the differential } d\left(-\frac{\kappa}{\mu}\cdot\frac{M}{r}\right) = f_b dr = \left(\frac{\kappa}{\mu}\right)\cdot\frac{M}{r^2}dr,$$

which corresponds to p7, expression 26, κ is absorption coefficient or average of absorbtion intensity, and μ is ordinal density of matter inside $\boldsymbol{S}^3$. As noted by Danilatos, $\frac{\kappa}{\mu}$ "*is the mass attenuation coefficient of the Beer-Lambert law in any absorbtion situation written in alternative form as a function of the area density (or mass thickness).*"

We use μ instead of ρ, in contrast to Danilatos, becaurse ρ is occupied in representing the Universe in terms of the stereographic projection $\boldsymbol{S}^3(\mathrm{r})$ of Landay-Lifshitz metric space LL, which is actually the Euclidean $\mathcal{E}^3$ space at close distances while curved with curvature 1 at fare away distances. A separate element/graviton α outside our visible or baryonic Universe can be interpreted as graviton cells in PG field undergoing a probable graviton transition into atoms, or whatever it is, into high level energy baryonic particles like leptons, neutrinos, etc., when the high energy barions gravitons transit into baryonic matter. The parameter threshold u at which the graviton transition presumably occurs is set to Λ.

Hereby we delve into «Extremal Subsystems of Monotonic Systems», in the form of $\{\pi^{+}H(\alpha)\}$ functions, which were called a +Monotone system for the purpose af Data Analysis (in terms of +MS, Mullat, 1976, p. 257). Which parameter in +MS must be chosen as variable, u or Λ, should be decided by introducing absorption density κ coefficient of the graviton α. Now it's clear that κ must be a variable but Λ must be a constant. The combine effect of κ and Λ produces the analogous effect of the parameter u in the construction of the +MS in question. Indeed, more natural is to set absorption density κ as a variable parameter leaving some constant value behind Λ.

The κ coefficient will make it possible to find the total absorption of barions in hyper-manifold $\boldsymbol{S}^3(r)$ embedded into its manifold volume $V.\boldsymbol{S}^3(r)$; mathematical derivation in the Appendix. This is an important decision, since it allows building gravitons' energy absorbtion scale using some extents of the redshift z. However, when performing simulations by trial and error with the NED database, it would be prudent to replace the absorbtion coefficient k evaluating its decrease in absorption coefficient κ in accord to a hazard decay function $h(z) = 1 - (½)^{z}$.

4. THE TALE OF THE SPACE CREATION

Our knowledge of the Universe is limited by the horizon of observations. This horizon is determined by the speed of light, whereby we can only observe those areas of the Universe from which the light has already reached us. Hence, we do not see the objects in their present state, but rather in the one in which they were at the time of the emission when the ray of light has reached us at the moment of observation. In view of the foregoing, it is assumed that the universe can be described in terms of some geometry, the main characteristic of which is the distance r to some point in the universe, regardless of whether the ray of light has reached the point or where the point is located.

The distant parts of the Universe, which we could observe on a large scale, for centuries, however, had, on average, a homogeneous and isotropic structure. Encoded in cosmology according to the Copernican principle, coefficients such as energy absorbtion, brightness, etc. should be the same at all points and in all distant directions. Assuming that the Copernican Principle is true, we can expect to obtain similar results when observing parts of the Universe at the same distance r from our observation point N in any direction.

4.1 Stereographical mapping

In crystallography, various projections are used for the spatial image of the crystals under study, their symmetry and limiting elements. The most commonly used is a gnomo-stereographic projection. The gnomon is a scientific instrument that can cast a shadow on a perpendicular plane to determine the declination of the sun throughout the year.

To construct a crystal projection, the latter is placed in the center of a spherical surface. The faces and edges of the crystal continue until they intersect with the spherical surface and are depicted as follows: the faces are in the form of arcs; the edges are in the form of points. This projection is called stereographic. For a more visual image of crystals, a gnomo-stereographic projection is used. In this case, it is not the face that is projected, but the perpendicular to it; the planes normal to them replace the projections of the edges. In gnomo-stereographic design, faces give points on a sphere, and edges — arcs.

We will work based on Occam's Razor (it has a history dating back to Aristotle) methodological principle of parsimony: "*You must not multiply things unnecessarily* or *You must not attract new entities unless absolutely necessary …*", accessed online, 08.08.2021). In particular, we are trying to abandon any high-rank tensors, time coordinates, laws of gravity, etc., focusing only on the standard quadratic forms of differential geometry.

4.2 Stereographical projection of two-dimensional surface

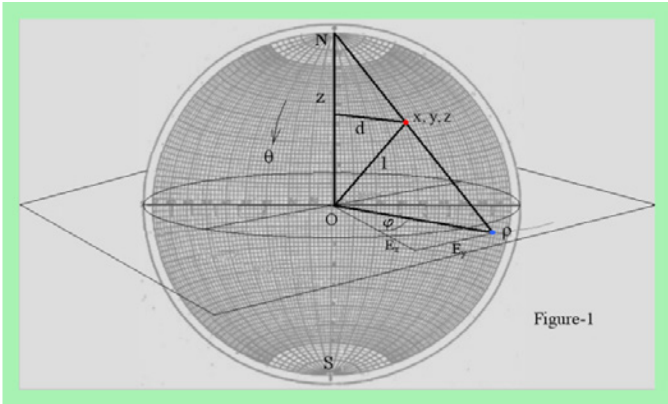


Figure 1: Surface $\mathcal{S}^2$ of the globe $\mathcal{R}^3$ stereographical projection at Euclidian Plane $\mathcal{E}^2$.

We will proceed first with a very short illustration of what is well known as stereographical projection. Let the $\mathcal{S}^2$ manifold geometry correspond to $x^2 + y^2 + z^2 = 1$ of curvature radius 1. The North Pole corresponds to the point $N = (0, 0, 1)$, and the South Pole is denoted by $S = (0, 0, -1)$. Conceive Euclidian plain $\mathcal{E}^2$ intersecting the origin $O = (0, 0, 0)$ perpendicular to the z-axis. We can project a line from N through $(x, y, z) \in \mathcal{S}^2$, which will intersect the plain at a distance ρ from the origin O. Using $\mathcal{S}^2$ geometry it can be verified that $d^2 + z^2 = 1$ what yields $d^2 = (1 - z)(1 + z)$.

Now convert $\frac{d}{\rho} = \frac{1 - z}{1}$ into $d^2 = \rho^2 (1 - z)^2$. For latter d^2's these d^2 yield $z = \frac{-1 + \rho^2}{1 + \rho^2}$, $d = \frac{2 \cdot \rho}{1 + \rho^2}$ what match up a stereographical projection, given by threefold projection/mapping $\left(\frac{2 \cdot \rho}{1 + \rho^2} \times \cos(\varphi); \frac{2 \cdot \rho}{1 + \rho^2} \times \sin(\varphi); \frac{-1 + \rho^2}{1 + \rho^2} \right)$ of two variable functions as a diffeomorphism $S^2 \to \mathcal{E}^2$ into Euclidian coordinates $(\mathcal{E}_x, \mathcal{E}_y)$ on the plain $\mathcal{E}^2$: $(\mathcal{E}_x, \mathcal{E}_y) = (\rho \cos(\varphi), \rho \sin(\varphi))$, $0 \le \varphi \le 2 \cdot \pi$, $0 \le \rho < \infty$.

Let us finally find the metric of our stereographical projection drawn by Figure 2. The partial derivatives of the projection/diffeomorphism represent the Jacobin matrix J. The transpose of the matrix J is thus given by three functions of two variables:

$$J^T = \left\| \begin{matrix} 2\cdot\frac{1-\rho^2}{\left(1+\rho^2\right)^2}\times\cos(\varphi); & 2\cdot\frac{1-\rho^2}{\left(1+\rho^2\right)^2}\times\sin(\varphi); & \frac{4\cdot\rho}{\left(1+\rho^2\right)^2} \\ -\frac{2\cdot\rho}{1+\rho^2}\times\sin(\varphi); & \frac{2\cdot\rho}{1+\rho^2}\times\cos(\varphi); & 0 \end{matrix} \right\|.$$

Consequently, the Gram Matrix as the static space metric tensor $G_{i,j} = J^T \times J$ yields $G_{i,j} = \frac{4}{\left(1+\rho^2\right)^2}\begin{pmatrix} 1 & 0 \\ 0 & \rho^2 \end{pmatrix}$ provided by Скляренко (2008). Herby, our $\boldsymbol{S}^2$ stereographical projection on Figure 2 is represented by $dl^2 = \frac{4}{\left(1+\rho^2\right)^2}\left(d\rho^2 + \rho^2 d\varphi^2\right)$. We will refer later to substitution $r = \frac{2\cdot\rho}{1+\rho^2}$ representing the "*inverse*" part of the diffeomorphism of $\boldsymbol{S}^2 \to \mathcal{E}^2$ or $\boldsymbol{S}^3 \to \mathcal{E}^3$ stereographic projections, where dl^2 denotes the metric in the Euclidian plain $\mathcal{E}^2$. This means that it will be possible to refer to manifolds $\boldsymbol{S}^3(r) \equiv \boldsymbol{S}^3\left(\frac{2\cdot\rho}{1+\rho^2}\right)$, which are now given as a function of ρ radius coordinate, and not of the radius r but as a projection radius ρ onto the Euclidean manifold $\mathcal{E}^3$, Figure 2.

4.3 Stereo-graphical projection of three-dimensional surface

Unfortunately only a few people can conceive a four-dimensional hyper-manifold $\boldsymbol{\mathcal{R}}^4$. However, the aforementioned process can be applied to a $\boldsymbol{S}^3$-dimensional surface of the $\boldsymbol{\mathcal{R}}^4$ dimensional globe. Around the North Pole $N = (0,0,0,+1)$ as a reference system center, try to envision drawing an imaginary $\boldsymbol{S}^3(r)$ manifold given by polar coordinates of radius r, $0 \le r \le 1$. Our $\boldsymbol{S}^3(r)$ manifold is of a fixed curvature of radius 1. Proceed in similar way already described above for an ordinary globe $\mathcal{R}^3$ encircling point N until the whole S^3 surface of the $\mathcal{R}^4$ globe is inflated.

At cosmological distances, the space purported to be homogeneously inflated with space energy and matter and is completely isotropic. The generic metric that meets these conditions is given by S^3 manifold of four-dimensional globe $\Re^4$. In the derivation below, we will consider only the case of closed model with positive curvature ≈ 1.

$$x^2 + y^2 + z^2 + r^2 = 1$$
$$x^2 + y^2 + z^2 \le r^2 \le 1$$

These equations represent so-called closed space manifolds $S^3(r)$ of curvature 1 on the surface enclosing four-dimensional hyper-globe $\mathcal{R}^4$

The spherical coordinates x, y, z are related to the E^3 coordinates by $\varphi = \tan^{-1}\left(\frac{y}{x}\right)$, $\theta = \cos^{-1}\left(\frac{z}{r}\right)$, where $r = \sqrt{x^2 + y^2 + z^2}$.

$x = r \cdot \cos(\varphi) \cdot \sin(\theta)$,
$y = r \cdot \sin(\varphi) \cdot \sin(\theta)$,
$z = r \cdot \cos(\theta)$, where $0 \le r < 1$, $0 \le \varphi \le 2 \cdot \pi$, and $0 \le \theta \le \pi$,

The stereographical projection S^3 from North Pole $(0,0,0,1)$ intersecting $\mathcal{R}^4$ at the origin $O = (0,0,0,0)$ perpendicular to line connecting North N with South Pole S is given by a quadruple of three variable functions as a diffeomorphism/mapping of S^3 into Euclidian $\mathcal{E}^3$ related to $\left(\mathcal{E}_x = \rho\cos(\varphi)\sin(\theta), \mathcal{E}_y = \rho\sin(\varphi)\sin(\theta), \mathcal{E}_z = \rho\cos(\theta)\right)$ — spherical coordinates, where $0 \le \rho < \infty$, $0 \le \varphi \le 2 \cdot \pi$, and $0 \le \theta \le \pi$:

$$\left(\frac{2\cdot\rho}{1+\rho^2} \times \cos(\varphi)\cdot\sin(\theta); \frac{2\cdot\rho}{1+\rho^2} \times \sin(\varphi)\cdot\sin(\theta); \frac{2\cdot\rho}{1+\rho^2} \times \cos(\theta); \frac{-1+\rho^2}{\rho^2+1}\right).$$

The partial derivatives of the projection/diffeomorphism represent the Jacobin matrix J, whereby its transpose J^T is given as follows:

$$\left\| \begin{matrix} 2\frac{1-\rho^2}{(1+\rho^2)^2}\times \\ \times\cos(\varphi)\sin(\theta) & 2\frac{1-\rho^2}{(1+\rho^2)^2}\times \\ \times\sin(\varphi)\sin(\theta & 2\frac{1-\rho^2}{(1+\rho^2)^2}\times \\ \times\cos(\theta & \frac{4\cdot\rho}{(1+\rho^2)^2} \\ -\frac{2\cdot\rho}{1+\rho^2}\times \\ \times\sin(\varphi)\sin(\theta) & \frac{2\cdot\rho}{1+\rho^2}\times \\ \times\cos(\varphi)\sin(\theta) & 0 & 0 \\ \frac{2\cdot\rho}{1+\rho^2}\times \\ \times\cos(\varphi)\cos(\theta) & \frac{2\cdot\rho}{1+\rho^2}\times \\ \times\sin(\varphi)\cos(\theta) & -\frac{2\cdot\rho}{1+\rho^2}\cdot\times \\ \times\sin(\theta) & 0 \end{matrix} \right\|$$

Consequently, Gram Matrix metric tensor $G_{i,j} = J^T \times J$ yields

$$G_{i,j} = \frac{4}{(1+\rho^2)^2} \times \left\| \begin{matrix} 1 & 0 & 0 \\ 0 & \rho^2\sin^2(\theta) & 0 \\ 0 & 0 & \rho^2 \end{matrix} \right\|,$$

,

which leads to the metric rod $dl^2 = \frac{4}{(1+\rho^2)^2}\left[d\rho^2 + \rho^2\left(\sin^2(\theta)d\varphi^2 + d\theta^2\right)\right]$.

4.4 Foundation of Planck satellite data in terms of stereographic projection

Before approaching this issue, it is necessary to start calculating the volume of 3-dimensional regions in our 3-dimensional Euclidean plane. It is easy to verify that the volume of the entire space is equal to $\lim \boldsymbol{S}^3(\rho)$ as $\rho \to \infty$, namely $\boldsymbol{S}^3(\infty) = 2\cdot\pi^2$. Now it remains for us to calculate which part in percentage is the volume $V.\boldsymbol{S}^3(\rho)$ in relation to $2\cdot\pi^2$. The following mathematical sequence is reduced to the following chain of formulas.

We know that in flat $\mathcal{E}^3$ topology, the rod volume dl^3 is equal to $dx \cdot dy \cdot dz$, whereas the rod length is given by $dl^2 = dx^2 + dy^2 + dz^2$. Applying the same rule to the previous flat expression for dl^2, we obtain

$$dl^3 = 8 \cdot \frac{\rho^2 d\rho \cdot \sin(\theta) d\theta \cdot d\varphi}{(1+\rho^2)^3},$$

within a coordinate triple: $0 \le \rho < \infty$, $0 \le \theta \le \pi$ and $0 \le \varphi \le 2\pi$. Hereby the expression

$$8\int_0^{2\pi}\int_0^{\pi}\int_0^{\rho} \frac{\xi^2 d\xi \cdot \sin(\theta) d\theta \cdot d\varphi}{(1+\xi^2)^3}$$

in the form of integral represents the space volume $V.\boldsymbol{S}^3(\rho)$ of a hyper-manifold $\boldsymbol{S}^3(\rho)$ with a radius ρ.

The *radius* $r = \frac{2 \cdot \rho}{1+\rho^2}$ can be interpreted as a new dimension, implying that the space volume is proportional to Euclidian space $\mathcal{E}^3$ at nearby distances. Taking the integral into account, we derive the expression of the volume:

$$V.\boldsymbol{S}^3(\rho) = 4\pi \cdot \frac{-\rho + \tan^{-1}(\rho) + \tan^{-1}(\rho)\cdot\rho^4 + \rho^3 + 2\cdot\tan^{-1}(\rho)\cdot\rho^2}{(1+\rho^2)^2}.$$

After accounting for the sub-expression $\tan^{-1}(\rho)$, we obtain

$$V.\boldsymbol{S}^3(\rho) = 4\pi \cdot \frac{(1+\rho^4+2\cdot\rho^2)}{(1+\rho^2)^2} \cdot \tan^{-1}(\rho) + 4\pi \cdot \frac{-\rho+\rho^3}{(1+\rho^2)^2}.$$

Finally, we arrive at $V.\boldsymbol{S}^3(\rho) = 4\pi \cdot \left(\tan^{-1}(\rho) + \rho \cdot \frac{-1+\rho^2}{(1+\rho^2)^2} \right)$.

To interpret the stereographic projection in order to confirm to the matter Composition put forward by the Planck Mission 2013 satellite data it is necessary to establish the share of the volume $V.\boldsymbol{S}^3(\rho)$ with respect to the entire volume $\boldsymbol{S}^3(\infty) = 2\cdot\pi^2$. Indeed, while the share

$$\mathrm{sh}(\rho) = \frac{2}{\pi}\left(\tan^{-1}(\rho) + \rho\frac{-1+\rho^2}{\left(1+\rho^2\right)^2}\right),\ \mathrm{sh}(\infty) = 1.$$

At https://sci.esa.int/web/planck/-/51557-planck-new-cosmic-recipe, we read "*Planck's high-precision cosmic microwave background map has allowed scientists to extract the most refined values yet of the Universe's ingredients. Normal matter that makes up stars and galaxies contributes just 4.9% of the Universe's mass/energy inventory. Dark matter (quantum vacuum, ed.), which is detected indirectly by its graviton influence on nearby matter, occupies 26.8%, while dark energy, a mysterious force thought to be responsible for accelerating the space capture of the Universe, accounts for 68.3%.*" accessed online 26/07/2022.

This understanding brings about not only one but also two divisions of the same metric as two different solutions of the equation $\mathrm{sh}(\rho_0) = 0.268$ for $\rho_0 = 0.675545953$, and $\mathrm{sh}(\rho_1) = 0.951$ for $\rho_1 = 3.069027963$. One can check that for dark matter or **Qv**-vacuum, and for baryonic or normal **Vm**-matter bubbles respectively, $0 \le \varphi \le 2\pi$, $0 \le \theta \le \pi$.

Qv: $\mathrm{sh}(\rho_0) = 0.268$	**De**: $\mathrm{sh}(\rho_1) - \mathrm{sh}(\rho_0) =$ $= 0.683$	**Vm**: $\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) =$ $= 0.049$
$0 \le \rho < \rho_0 =$ $= 0.675545953$	$\rho_0 \le \rho < \rho_1 =$ $= 3.069027963$	$\rho_1 \le \rho < \infty$

Table 1: Stereographical Composition: **Qv-** as quantum vacuum, **De-** as dark energy.

We will investigate the metric of space given by the form considered in "Classical Field Theory", Landau-Lifshitz (LL), 3rd Revised English Edition, 1971, p. 336:

$$dl^2 = \frac{dr^2}{1-\left(\frac{r}{a}\right)^2} + r^2 \cdot \left[\sin^2(\theta)\cdot d\varphi^2 + d\theta^2\right]. \tag{1}$$

The metric depends on the curvature radius a, where the r can vary from 0 to a, and where φ and θ are in the intervals $[0 \le \varphi \le 2\pi]$ and $[0 \le \theta \le \pi]$. It turns out that the quadratic metric (1) can be considered as a stereographic projection of the surface $\boldsymbol{S}^3$ of the four-dimensional ball $\boldsymbol{\mathcal{R}}^4$ onto the flat Euclidean space E^3. Indeed, as an exercise, the substitution $r = \frac{r_1}{1+\frac{r_1^2}{4\cdot a}}$ for $0 \le r_1 \le a$ lead to

$$dl^2 = \left(1+\frac{r_1^2}{4\cdot a^2}\right)^{-2} \cdot \left(dr_1^2 + r_1^2 \cdot d\theta^2 + r_1^2 \cdot \sin^2\theta \cdot d\varphi^2\right). \tag{2}$$

According to LL's idea, at each point of the three-dimensional manifold $\boldsymbol{S}^3$ the metric (1) would be locally Euclidean, but curved at large distances. The metric transformation, the mathematical derivation of which in section 4.3 and after further substitution $r_1 = 2\cdot a\cdot\rho$ for $a=1$, will exactly match its stereographic metric form:

$$dl^2 = \frac{4}{\left(1+\rho^2\right)^2}\left[d\rho^2 + \rho^2\left(\sin^2(\theta)d\varphi^2 + d\theta^2\right)\right]. \tag{3}$$

Moving $r = \frac{2\cdot\rho}{1+\rho^2}$ from $r=0$ to 1 (hence moving $\rho = 0$ to 1), and then backwards moving $r=1$ to 0 (hence moving $\rho=1$ to ∞) it appears to be two bubbles inside the stereographic interval $[0 \le \rho = 1 < \infty)$. At this interval, these two bubbles are spaced along the boundary $\rho = 1$ in such a way that the bubbles overlap each other at every point at a distance r from the common Center$(0,0,0)$. The volume of each bubble is equal to π^2.

The reader can now check that the substitution of $r = \frac{2\cdot\rho}{1+\rho^2}$ into the form (1) leads exactly to the same metric as (3). Indeed, according to LL, the substitution $r = r_1 \cdot \left(1 + \frac{r_1^2}{4 \cdot a^2}\right)^{-1}$ for $0 \le r_1 \le a$, would at every point of a 3-d manifold $\boldsymbol{S}^3$ lead to

$$dl^2 = \left(1 + \frac{r_1^2}{4 \cdot a^2}\right)^{-2} \cdot \left(dr_1^2 + r_1^2 \cdot d\theta^2 + r_1^2 \cdot \sin^2\theta \cdot d\varphi^2\right).$$

By substitution $r_1 = 2 \cdot a \cdot \rho$ the LL metric can be converted exactly into our stereographic metric for $a = 1$. Now, moving $r = \frac{2 \cdot \rho}{1 + \rho^2}$ from $r = 0$ to 1 (hence moving $\rho = 0$ to 1), and then backwards moving $r = 1$ to 0 (hence moving $\rho = 1$ to ∞) it appears to be two bubbles inside the stereographic interval $[0 \le \rho = 1 < \infty)$. At this interval, these two bubbles are spaced along the boundary $\rho = 1$ in such a way that the bubbles overlap each other at every point at a distance r from the common Center $(0,0,0)$. The volume of each bubble is equal to π^2.

This proves that the LL metric is nothing but a stereographic projection of the surface of the 4-dimensional manifold $\mathcal{R}^4$ into the Euclidean flat 3-x dimensional space $\mathcal{E}^3$. In particular, we will work without any high rank tensors, time coordinate, laws of gravity, etc., focusing only on standard quadratic forms of differential geometry. This dl^2 was considered in "Classical Field Theory", Landau-Lifshitz (LL), 3rd Revised English Edition, 1971, p. 336.

In order to be convinced of the above, we need to calculate the volume of the manifold $V.\boldsymbol{S}^3(r)$ within LL metric in interval $[0, r)$. Indeed

$$V.\boldsymbol{S}^3(r) = \int_0^{2\pi} \int_0^{\pi} \int_0^{r} \frac{\xi^2 d\xi \cdot \sin(\theta) d\theta d\varphi}{\sqrt{1 - \xi^2}} = 2 \cdot \pi \cdot \left\{\sin^{-1}(r) - r \cdot \sqrt{1 - r^2}\right\}.$$

We can check that for vacuum $\rho_0 = 0.675545953$ and for normal matter $\rho_1 = 3.069027963$

$$\frac{V.S^3\left(r_0 = \dfrac{2\cdot\rho_0}{1+\rho_0^2}\right)}{2\cdot\pi^2} = 0.268 \text{ and } \frac{V.S^3\left(r_1 = \dfrac{2\cdot\rho_1}{1+\rho_1^2}\right)}{2\cdot\pi^2} = 0.049\,.$$

5. THE Γ-EQUATION

In connection with what will be discussed, it is necessary to make the following remark, which would be clear to a layman. We often use this method of narration wherever it is convenient.

Layman's Physics. *It is widely understood that when a figure skater extends her arms as far as possible from her body with a sharp push, she initiates a rotational movement. As she starts to control her spin, she gradually draws her arms closer, causing her rotation to speed up. This principle can be compared to the atomic model proposed by Niels Bohr.*

From a layman's perspective, the "aging" of atoms may be associated with a redshift. According to the law of energy conservation, atoms gradually lose potential energy, transitioning from the initial push of potential energy, carried by gravitons, into kinetic energy. It becomes evident that a quantum of light, or a photon, emitted from the outermost orbits of distant atoms will have a longer wavelength and therefore carry less energy as it travels through space, compared to photons from younger atoms.

In older atoms, the so-called Bohr orbits of electrons around the nucleus are closer to the nucleus. This leads to a greater outflow of energy as we move from larger redshift values (z) to smaller ones, implying that photons from galaxies at great cosmological distances (containing younger atoms) exhibit lower kinetic energy than those from galaxies nearer to us, which contain older atoms.

To simulate how energy is captured by the universe, we use the average energy absorption coefficient κ, represented by the function $1-(½)^z$. This coefficient describes a decrease of absorbtion as z increases, reflecting the diminished energy transfer associated with increasing redshift.

In formulating speculations similar to, cf. a) Mullat (1995), using the Γ-equation describing the current mass-energy composition in the Universe, our aim is to identify some stable states embedded into the four-dimensional hyper-globe $\mathcal{R}^4$ of a curvature radius 1 given by $x^2+y^2+z^2+r^2=1$ as topologies among three-dimensional ordinary manifolds $\mathcal{S}^3(r)$ of radius r, $0 \le r \le 1$, $x^2+y^2+z^2 \le r^2$.

The Copernican Principle, as an ideal attribute, can be assigned with two-dimensional surface $\mathcal{S}^2$ of a three-dimensional globe $\mathcal{R}^3$. Extending the Principle to the manifold $\mathcal{S}^3$ enclosing a hyper-globe $\mathcal{R}^4$, we preserve the same ideal properties. Therefore, stereographic $\mathcal{S}^3(\rho_0)$, $\mathcal{S}^3(\rho_1)$ embedded into hyper-globe $\mathcal{R}^4$ corresponds to the Principle idealizing homogeneity and isotropy of the Universe. Before proceeding further with the analysis, we will present a hypothetical situation based on the assumption that the Copernican Principle is an ideal absolute.

We assume that closed three-dimensional stereographic $\mathcal{S}^3(\rho)$ manifolds of radius ρ, $0 \le \rho \le \infty$, are surrounded by energy-field within the globe $\mathcal{R}^4$ of curvature radius 1. It should be reiterated that the observer does not necessarily have to be placed at the North Pole of $\mathfrak{R}^4$. However, we shall adopt $(0,0,0)$ in $\mathcal{S}^3(\rho)$ as the stereographic reference system origin O, while allowing the observer to be positioned at any point within the manifold $\mathcal{S}^3(\rho)$. Such representation, however, ignores explanations of some known observational anomalies, such as super-void areas in Cosmos, local zones with higher and lower density of matter, etc. as anomalies in graviton transitions of energy-field into quantum vacuum and baryonic matter.

According the to basic assumtions of Le Sage's theory,[i] in Danilatos interpretation of inverse squre root law, and subsequent Fatio's "*Particles Bombardment*" theory of push gravity, given a sherical body of mass M of radius r from its center, the tention of the graviton vector-field at a distance r from O equals $-\left(\frac{\kappa}{\mu}\right)\frac{M}{r}$, where κ is the graviton energy absorbtion and μ is the average ordinal density of matter of the mass

M. We can further hypothesize the process of graviton transition, which occurs within the manifold $S^3(r)$—that is, at a distance r from the origin O. It is plausible to speculate that, at a distance r from the origin O, in the vector-field, the graviton transition takes place if the field tension intensity is strong enough—e.g. below the value of the universal constant Λ, i.e., at $-\left(\frac{\kappa}{\mu}\right)\frac{M}{r} < -\Lambda$. This will start gravitons absorbtion on the surface of $\Re^4$ and cannot be stopped or arrested until

$$-\left(\frac{\kappa}{\mu}\right)\cdot M + \Lambda \cdot r = 0. \qquad (4)$$

The energy-field space and baryonic matter creation, according to our speculative postulate, is thus determined by a Γ-equation. As previously noted, once the process of space or matter creation begins, it cannot cease or be arrested because by supposition a fixed point equilibrium should be reached, i.e., an increase in the mass M used in solving the Γ-equation in fact is increasing in a higher order than the increase in radius r needed for the mass M to be stipulated by the Γ-equation solution.

Let us now turn attention to graviton vector-field potential energy level on the manifold $\Re^4$ surface that forms the three-dimensional vectors (x, y, z) denoting manifold $\boldsymbol{S^3}$. In fact, these vectors represent the level of potential energy at the distance r from the centum of the manifold $\boldsymbol{S^3}(r)$ of radius r. As already emphasized by our speculative postulate, the space-energy composition undergoes graviton transition, which allegedly occurs on the three-dimensional manifold embedded into the four-dimensional hyper-globe denoted by $\boldsymbol{\mathcal{R}^4}$.

We are now ready to introduce the parameter λ, which allegedly represents a fine-tuning or calibration factor for the energy field. It appears in the background vector-field energy potential scalar function $-\left(\frac{\kappa}{\mu}\right)\frac{M}{r^{\lambda}}$, consistent with MOND's amendment (Milgrom, 1983), and as similarly defined in Danilatos' expressions (26, 56), 2024. In line with this speculation on space-energy composition, energy transition occurs at a level equal to Λ, representing a universal constant as previously discussed. Thus, the graviton transition occurs by violating the Γ-equation $-\left(\frac{\kappa}{\mu}\right)\frac{M}{r^{\lambda}}+\Lambda=0$, where $\kappa\cdot M$ corresponds to the total number of gravitons absorbed by the manifold $\boldsymbol{S}^3(r)$.

The latter equation describes the stable set applied to the graviton vector-field composition, represented as a plus monotone system (+MS). In the subsequent analysis, we will replace M with its mass, expressed as $M=V.\boldsymbol{S}^3(r)\cdot\mu$, where $V.\boldsymbol{S}^3(r)$ represents the total volume of the manifold $\boldsymbol{S}^3(r)$ absorbing the gravitons. Here, μ signifies the average density of the manifold's mass. Note that we previously referred to the coefficient κ as the average absorption density. The product of μ and the volume $V.\boldsymbol{S}^3(r)$ corresponds to the total mass M of the manifold $\boldsymbol{S}^3(r)$ during initial inflation and the subsequent matter-layering process. Consequently, according to equation (4), the Γ-equation may be rewritten as $-V.\boldsymbol{S}^3(r)\cdot\kappa+\Lambda\cdot r^{\lambda}=0$. In Section 7, we provide a derivation of the volume $V.\boldsymbol{S}^3(r)$ of the manifold $\boldsymbol{S}^3(r)$ using the LL metric.

In accordance with Γ-equation the surface rod dl^2 of three-dimensional manifold $\boldsymbol{S}^3(r)$, $0\le r<1$, $0\le\varphi\le 2\pi$, $0\le\theta\le\pi$ yields a stereographical projection of $\boldsymbol{S}^3(r)$ given by

$$dl^2=\frac{4}{\left(1+\rho^2\right)^2}\left[d\rho^2+\rho^2\left(\sin^2\theta\cdot d\varphi^2+d\theta^2\right)\right],$$

where $r=\frac{2\cdot\rho}{1+\rho^2}$ and $0\le\rho<\infty$, which guarantees that the manifold is mapped into a flat $\mathcal{E}^3$ topology at nearby distances like a stereographical projection of S^3 from North Pole into Euclidian static space $\mathcal{E}^3$. Hereby, the rod of the stereographical volume is defined by

$$dl^3 = \frac{8 \cdot \rho^2}{\left(1+\rho^2\right)^3} d\rho \cdot \sin(\theta) d\theta \cdot d\varphi, \quad 0 \le \rho < \infty, \quad 0 \le \varphi \le 2\pi \quad \text{and} \quad 0 \le \theta \le \pi.$$

The expression $8\int_0^{2\pi}\int_0^{\pi}\int_0^{\rho} \frac{\xi^2 d\xi \cdot \sin(\theta) d\theta \cdot d\varphi}{\left(1+\xi^2\right)^3}$ represents the volume of radius ρ of hyper-manifold $\boldsymbol{S}^3(\rho)$ of ρ-"*radius*". Taking the integral into account, we obtain:

$$\text{V}.\boldsymbol{S}^3(\rho) = 4\pi \cdot \left(\tan^{-1}(\rho) + \rho \cdot \frac{-1+\rho^2}{\left(1+\rho^2\right)^2} \right).$$

It thus can be easily verified that $\text{V}.\text{S}^3(\infty) = 2\pi^2$ represents the entire hyper-manifold volume.

5.1 Layering Dynamics of the Universe

Imagine a sphere $\boldsymbol{\mathcal{R}}^3$ with a radius of 1, and suppose we have some black paint. Now, envision that the black paint represents space being created through a graviton transition from a latent energy vector-ield. Select any point on the surface of the sphere and draw a small circle of radius (where $0 < o << 1$) around that point—let's say we encircle the North Pole, N. Then, paint the area inside this small circle with black paint. Next, increase the radius o and draw a larger circle around the same N point. Once again, cover the newly created area with black paint. Continue this process, expanding the circle and painting the surface, until you reach the opposite side of the sphere at the South Pole S. Eventually, the entire sphere $\boldsymbol{\mathcal{R}}^3$ will be covered in black. This process illustrates a "layering dynamics" hypothesis of the universe, where graviton transitions occur, converting energy from a vector-field into quantum vacuum and baryonic matter. This conceptual model bypasses the need for General Relativity (GR) and the traditional timeline by instead visualizing the universe as a sequence of three-dimensional surfaces or manifolds $\boldsymbol{S}^3$, embedded within a four-dimensional globe $\boldsymbol{\mathcal{R}}^4$). In this framework, the distance rod dl^2 represents a stereographic projection of S^3, with curvature 1, mapped into flat Euclidean space $\mathcal{E}^3$, similar to the methods discussed by Landau and Lifshitz in *The Classical Theory of Fields*, §107, p.348.

We established the "*layering dynamics*" of the universe as a hypothesis of graviton transition exploiting a nomenclature of energy-field transition into quantum vacuum and baryonic matter without use of GR and time line as a sequence of 3-dimentianal surfaces/manifolds S^3 of 4-dimentional globe $\mathcal{R}^4$. The dl^2 -s represent a stereographical projection of S^3 with curvature 1 into Euclidian $\mathcal{E}^3$ flat space; cf. Landau and Lifshitz, "*The Classical Theory of Fields*", §107, p.348.

Hence, with regard to the Γ-equation, the equation can now be rewritten as:

$$\Gamma(\kappa,\rho) = -4\pi \cdot \left(\tan^{-1}(\rho) + \rho \cdot \frac{-1+\rho^2}{\left(1+\rho^2\right)^2} \right) \cdot \kappa + \Lambda \cdot \rho^{\lambda} = 0 .$$

This equation provides a mathematical structure for the graviton transition model, linking curvature, energy vector-fields, and the evolution of space within this cosmological framework. The equation also clarifies the steps and ideas while ensuring that the scientific concepts are easier to follow.

In order to calibrate Γ-equation, which must be taken as speculative, the roots must be accurately aligned with the latest Plank Mission data of the mass-energy composition in the Universe. In fact, Γ-equation can almost always be solved for two roots, where $\rho_0 < \rho_1$. The case with one root $\rho_0 = \rho_1$, as well as that described by $\rho_S = 0$, exists as well, as do those including no roots at all.

The two roots $\rho_0(\kappa)$ and $\rho_1(\kappa)$ resolving the Γ-equation are exponential functions supporting the Universe growth with acceleration depending on average absorbtion density coefficient κ, while κ is linearly decreasing in semi-intervals:

$$\begin{pmatrix} \text{Planck Era} \to \kappa \approx 10^{12} \geq \ldots \geq \text{Vacuum Ages Phase} \to \kappa \approx 10^3,\ \text{Current} \\ \text{Phase of Universe} \to \kappa \approx 0.12457 \geq\geq \text{Final Death Phase} \to \kappa \approx 0.08727 \end{pmatrix}.$$

Nothing can stop us from moving the $\kappa \to \infty$ in such a way as to diminish the size of quantum vacuum or space bubble $S^3(\rho_0)$ by moving $\rho_0(\kappa) \to 0$. This means that quantum vacuum bubble penetrates beyond the so-called Planck wall, with extent $\rho_0(\mu)$ smaller than the Planck constant $\hbar = 6.62606957 \cdot 10^{=34}$, can be included in our model.

By triple $\{\kappa = 0.12457, \lambda = 0.83751, \Lambda = 0.91499\}$ we achieved the best match with Planck mission 2013 satellite data, i.e., matching 68.3% energy-field, 26.8% quantum vacuum and 4.9% baryonic matter using component function $\mathrm{sh}(\rho) = \frac{2}{\pi}\left(\tan^{-1}(\rho) + \rho \frac{-1+\rho^2}{(1+\rho^2)^2}\right)$. For technical reasons, we cannot calculate the solution of Γ-equation for $\kappa > 10^{12}$.

Qv: *Quantum Vacuum* $\mathrm{sh}(\rho_0) = 0.268$	**Be:** *Background Energy vector-field* $\mathrm{sh}(\rho_1) - \mathrm{sh}(\rho_0) = 0.683$	**Vm**: *Visual/Baryonic Matter* $\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) = 0.049$	
$0 \le \rho < \rho_0 =$ $= 0.675545953$	$\rho_0 \le \rho < \rho_1 =$ $= 3.069027963$	$\rho_1 \le \rho < \infty$	
$\kappa \approx 10^{12}$, Planck wall Epoch or Era of the Big Bang	$\kappa \approx 10^{3}$, The Universe quantum vacuum Phase	$\kappa \approx 0.12457$, Current Phase of the Universe	$\kappa \approx 0.087267626$, The Death Phase of the Universe
Quantum Vacuum/Space Composition			
$\mathrm{sh}(\rho_0)\% \approx$ $3.302832273 \cdot 10e-17$	$\mathrm{sh}(\rho_0)\% \approx$ $\approx 0.000079175448461$	$\mathrm{sh}(\rho_0)\% \approx$ ≈ 26.784557217	$\mathrm{sh}(\rho_0)\% \approx$ ≈ 67.912846576
Background Energy-field Composition			
$\mathrm{sh}(\rho_1)\% - \mathrm{sh}(\rho_0)\% \approx$ $\approx 100\%$	$\mathrm{sh}(\rho_1) - \mathrm{sh}(\rho_0) \approx$ ≈ 99.9999208245515	$\mathrm{sh}(\rho_1) - \mathrm{sh}(\rho_0) \approx$ ≈ 68.300360425	$\mathrm{sh}(\rho_1) - \mathrm{sh}(\rho_0) \approx$ $\approx 0.00\%$
Visual or Baryonic Matter Composition			
$\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) \approx$ $\approx 0.00\%$	$\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) \approx$ $\approx 0.000000000000057$	$\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) \approx$ ≈ 4.914972357	$\mathrm{sh}(\infty) - \mathrm{sh}(\rho_1) \approx$ ≈ 32.087153424

Table 1: The function $\mathrm{sh}(\rho)$ readily explains the static space dynamics

The Table 1 understanding brings about not only one but also two divisions of the same metric as two different solutions of the equation $sh(\rho_0) = 0.268$ for $\rho_0 = 0.675545953$, and $sh(\rho_1) = 0.951$ for $\rho_1 = 3.069027963$. One can check that for the quantum vacuum or for the **Qv**-vacuum, and the baryonic or normal **Vm**-matter bubbles respectively, $0 \le \varphi \le 2\pi$, $0 \le \theta \le \pi$.

When the inflation time line in the Standard Model of the Big Bang began, column one defend our view that a positive root $\rho_0 \approx 0$ can be interpreted as infinitesimally small space volume of matter with radius $\rho_0 \approx 0$. As the SM inflation phase of the Big Bang developed further — the second column — the emergence of baryonic matter was lagged behind the appearance of quantum vacuum. We can rephrase this speculation believing that in the inflation phase only the quantum or vacuum space prevailed.

Column 3 (http://sci.esa.int/planck/51557-planck-new-cosmic-recipe/, last visited 09/10/2024) of the table shows an attempt to compare the composition of energy-field, quantum vacuum and baryonic matter, with satellite data. Despite the fact that satellite data were obtained on the basis of the SM, the most suitable parameters Λ, λ and coefficient κ with great accuracy fit into our phase transfer model as the basis for calculating distances to galaxies. Last column shows the death phase, when $\rho_0 \approx \rho_1$: the energy-field source will be almost exhausted—both the quantum vacuum and baryonic matter bobbles will start to slow down their alleged acceleration of growth.

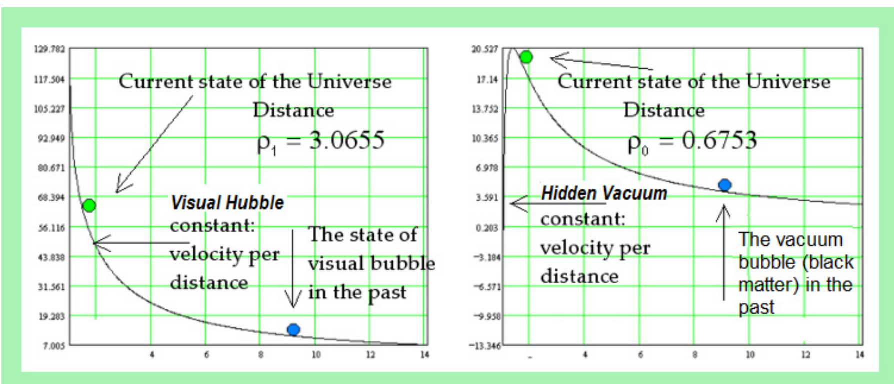


Fig. 2 and **Fig. 3:** Reveal the fundamental difference in the dynamics of quantum vacuum and baryonic matter highlighted in Table 1.

According to our analyses, which contradict the laws of gravity implying that the baryonic matter should start to contract, it allegedly continues to expand. This effect is readily apparent in the graphs depicted in Fig. 2 and Fig. 3. Indeed, they indicate that the baryonic matter creation velocity within the manifold $S^3(\rho_1)$ continues to accelerate, whereby as the manifold inflated with space continues to increase in size, the average absorbtion density also decreases. However, when the absorbtion density reaches the vicinity of the critical value κ, the alleged quantum vacuum $S^3(\rho_0)$ volume of quantum vacuum or space seem to be better aligned with the laws of gravity. Indeed, as shown in Figure 3, the creation of quantum vacuum does not stop although the acceleration completely stops before it becomes negative, that is, the growth of the radius of the quantum vacuum slows down, and the growth of its volume begins to slow down, respectively. So, in accordance with thermodynamic laws, in the vicinity of the critical value, as can be seen from Figure 3, the density of absorbtion-field continues to decrease, but more slowly. We might thus conclude that the dynamics of the evolution of quantum vacuum and baryonic matter, accounting for the decreasing absorbtion density, still corresponds to the known laws of physics.

5.2 Absorbtion density scale construction

Parameters Λ, λ and coefficient κ represent a triplet in Γ-equation, where $-\Lambda$ is a mass-energy graviton transition level, at which the transition occurs and which characterizes some speculative potential energy-field demarcation stripe on the scale inverse to radius ρ of the manifold S^3. Similarly, λ is a tuning or calibrating parameter for the postulated potential energy of the gravitation field itself, and κ denotes the Push Gravity absorbtion coefficient of the manifold S^3. By introducing the curvature of the manifold S^3 equal to 1, we have succeeded in calibrating the roots of the equation, which results in the following values for the aforementioned triplet: $\Lambda = 0.91499$, $\lambda = 0.83751$ and

$\kappa = 0.12457$. This parameter value set provides what being said the best fit to the Planck Mission Statement. It should be noted that we use a modified vector energy tenstion of graviton field in the form of function $-\left(\frac{\kappa}{\mu}\right)\cdot\frac{M}{\rho^{\lambda}}$ that for $\lambda < 1$ declines more rapidly at nearby distances (i.e., when $0 < \rho \leq 1$) than for faraway distances (when $1 < \rho < \infty$).

Before we proceed further, it is necessary to establish the share of the volume $V.\boldsymbol{S}^3(\rho)$ with respect to the entire volume $V.\boldsymbol{S}^3(\infty) = 2\pi^2$ in order to conform to the quantum vacuum and baryonic matter composition put forth by the Planck Mission satellite data. Indeed, the share equals $sh(\rho) = \frac{2}{\pi}\left(\tan^{-1}(\rho) + \rho\cdot\frac{-1+\rho^2}{\left(1+\rho^2\right)^2}\right)$. For the triplet given above, the roots $\rho_0 = 0.67535$ and $\rho_1 = 3.06548$ solve Γ-equation. It can, cf. Table 1, thus be verified that:

Quantum Vacuum / Space:	$Qv\% \mid sh(\rho_0) \approx 26.785\%$,
Background / Energy-Field:	$Be\% \mid sh(\rho_1) - sh(\rho_0) \approx 68.300\%$,
Visual / Baryonic Matter:	$Vm\% \mid sh(\infty) - sh(\rho_1) \approx 4.915\%$.

These percentages in Table 1, with regard to the Plank Mission Statement, allow us to refer to ∞ as the baryonic matter crossing/starting point, which terminates at ρ_1. We can also refer to ρ_0 as the energy-field starting point, whereby the energy-field terminates when it reaches ρ_1, while the quantum vacuum commences at 0 and ends at ρ_0. The inverse stereographical distance $r_0 - r_1$ in r-reference system $r = \frac{2\cdot\rho}{(1+\rho^2)}$ denotes the energy-field width. From the above, it can be inferred that, while the percentages align with the Planck Mission Statement nearly perfectly, the roots ρ_0 and ρ_1 produce a good fit only when $\kappa = 0.12457$. Whatever this value κ of the absorbtion density coefficient represents or is interpreted to imply, the $\kappa = 0.12457$ points at an alleged current state of the Universe.

5.3 The origin of the scale of absorbtion

The conclusion made here is based on the premise that, in line with our Speculation, the manifold composition must stop changing when the absorbtion density declines below the threshold 0.08727. In this case, the quantum vacuum will *collapse into or be in contact* with the visible manifold when $\kappa^* \approx 0.08727$ because of $\rho_0 \approx \rho_1$. By implementing a ratio scale of density on the κ-axis as a ratio of absobtion coefficient κ to some, what is called critical absorbtion κ^*, i.e., $\frac{\kappa}{\kappa^*}$, while moving from higher to lower absorbtion values, the roots should confirm, or at least not contradict, the currently accepted statements about the Universe dynamics.

Let introduce a scale that commences at the point corresponding to the critical absorbtion ratio $\frac{\kappa}{\kappa^*} \approx 1$, $\kappa \approx 0.08727$. The manifold points on this scale at the ratio $\frac{\kappa}{\kappa^*} \approx 1.42751$ as the current composition. In contrast, for very high values $\frac{\kappa}{\kappa^*}$ on the scale κ, a small or infinitely small clump of quantum vacuum can suddenly undergo an initial absorbtion transition from the zero solution $\rho_S = 0$ of our speculative Г-equation, yielding $Hv\% \approx 3{,}30283 \cdot 10^{-17}\%$ of the quantum vacuum and $Vm\% \approx 0.00 \cdot 10^{-17}\%$ for the visual or baryonic matter. This fits well with the current postulate on the beginning of "*Dark Ages of the Universe*", Trimble (1987), indicating that background energy-field $Be\% \approx 100\% - 0.00 \cdot 10^{-17}\%$ constitutes almost the entire manifold, as illustrated by Figure 7 in the Appendix. At the other end of the scale the alleged composition suggests $Vm\% \approx 32.67\%$ and $Hv\% \approx 67.33\%$, when absorbtion decreases, and thus starts approaching the critical level $\kappa^* \approx 0.08727$, the roots of the equation cease to exist.

The roots of our speculative Γ-equation do not contradict, but rather confirm the "*flatness problem*" $\Omega_0 \approx 1.0002 \pm 0.0026$ of the Universe on traditional density scale Ω, when it is outside the generally accepted critical density $\Omega \approx 1$, to expand forever, as was assumed in the Standard Model. Indeed, the similarly $\frac{\kappa}{\kappa^*} \to 1$ with the last possibility for finding the roots of Γ-equation is reached when the width $\rho_0 - \rho_1$ of the energy-field will approach zero.

5.4 Redshifts transformation into absorbtion scale

Invariance is one of the fundamental properties of the absorbtion scale κ (as well as any other scale), since it allows linear transformations to be implemented, supporting the theoretical construction irrespective of the chosen scale interval. Here, we will illustrate the invariance by a linear transformation of distances in the scale of energy absorbtion from energy vector-field as a creation of the space and matter substituting the coefficient κ into the equation:

$$\Gamma(\kappa,\rho) = -4\pi \cdot \left(\tan^{-1}(\rho) + \rho \cdot \frac{-1+\rho^2}{\left(1+\rho^2\right)^2} \right) \cdot \kappa + \Lambda \cdot \rho^{\lambda} = 0,$$

where $\Lambda = 0.91499$ and $\lambda = 0.83751$. In solving this equation with respect to distances ρ, we obtain a theoretical distribution of distances, which will be appropriately compared with the distances in the original *Mean (MpC)* column of NED data with 15000 records; cf. Table 4 below.

First we return to the question of the average energy absorbtion in the Universe. As already noted, when estimating the absorbtion coefficient κ, it was relatively easy to take into account the "*independent distances*" given in +/- percentages of Table 3 of +over/–under estimates below. It was also comparatively straightforward to transform the distances into the light years time scale indicating the propagation of light through static space until light from extragalactic objects reaches the telescope of the observer. In making this connection, it was also plausible to accept that light from extragalactic objects, indicated by column *Mean (MpC*), was emitted at some point in the past, with such various moments of origin denoted as $[\tau_o, \tau_n]$ representing some interval determined by the closest and the farthest object in the column *Mean (MpC)*. On the other hand, we have repeatedly pointed out the theoretical possibility of describing events in static space by the absorbtion density μ dynamics of energy distribution in the Universe. Thus, at this juncture, it should be clear that our reasoning leads to the emergence of a certain interval $[\overline{\kappa}_o,...,\overline{\kappa}_n]$ of average absorbtions $\overline{\kappa}$. Indeed, given that $\Lambda = 0.91499$ and $\lambda = 0.83751$, such an interval can be constructed, thus supporting our claim that energy absorbtion can be used in place of the time scale events. These conditions result in obtaining solutions of Γ-equation that are reasonably matching with the +over/–under estimates in the *Mean (MpC)* column of Table 4.

To summarize the essence of calculating distances using Γ-equation, in accordance with the theory, it is necessary, what being said, to find a certain interval of absorbtions coefficients $[\overline{\kappa}_o,...,\overline{\kappa}_n]$, which would allow us to calculate distances. We do not have any methodology for choosing such an interval. All that can be counted on is a trial and error method. Nevertheless, as the trial and error method shows, it turned out to be necessary to consider three intervals on redshifts scale separated by two milestone points: $z_1 = 0.0015$ and $z_2 = 0.011118$. As a result, we have the opportunity to combine calculations into one procedure for calculating distances, both for small, moderate and significant redshift values. A similar separation of z values is already known for long time since the Hubble law is very accurately fulfilled for the small z values of redshifts. However, for large values, the Hubble's law validity is in doubt. The reader will be able to verify this further by viewing the Table 2.

5.4.1 Linear Transformation of z

Given the redshift z in the interval $[z_o = 0 < ... < z_n = 10.99]$ we tried to estimate the absorbtion coefficient decrease in the form of $h(z) = 1 - (½)^Z$ exponent's decay function incorporation in the following three cosmological redshifts extents:

$$[z_0 = 0 \le z < z_1 = 0.0015 \le z < z_2 = 0.11118 \le z < z_n = 10.99].$$

The function $\kappa(z)$ is being defined piecewise over different intervals of z. Each interval uses a linear function of some function $h(z)$. Specifically, the piecewise linear functions for each segment of z are:

$$\kappa(z) = \left| \begin{array}{l} 98.188007 \cdot h(z) + 0.16027 \text{ for } z \in Z_1 = [z_0 = 0 \le z < z_1 = 0.0015], \\ 97.926578 \cdot h(z) + 0.42157 \text{ for } z \in Z_2 = [z_1 \le z < z_2 = 0.11118], \\ 102.812981 \cdot h(z) + 0.53757 \text{ for } z \in Z_3 = [z_2 \le z < z_n = 10.99]. \end{array} \right.$$

Each of these linear transformations depends on the spoecific range of z is in (i.e., Z_1, Z_2 and Z_3), and $h(z)$ is some function that likely encodes information about redshift or some some other relevant physical variable.

5.4.2 Smoothing Function

We sugest that instead of using the piecewise linear function derectly, they applied a smoothing technoque to $\kappa(z)$, averaging the function's value at z, $z - 0.0001$, and $z + 0.0001$:

$$\overline{\kappa}(z) = ⅓ \cdot (\kappa(z - 0.0001) + \kappa(z) + \kappa(z + 0.0001)).$$

This smoothing is likely done to avoid discontinuities at boundaries of the piecewise function.

5.4.3 Distance Calculation Procedure

This part deals with the calculation of distancies to extraterrestial objects using the function $\Gamma(\overline{\kappa}(h), \rho)$, which is set to zero. The distances depend on the region of z (either Z_1, Z_2 or Z_3). The estimated distance to the extraterristial object is given by $\overline{\rho}(z) - \rho_1$, where $\overline{\rho}(z)$ is the root of the equation $\Gamma(\overline{\kappa}(h), \rho) = 0$, and $\rho_1 = 3.065505$. This procedure could be related to a specific cosmological model, and it means testing it against Hubble and modulus $m - M$ distances (this likely refers to comparing against cosmological distances measured by using different methods, e.g., luminosity distance, or with reg. to formula of Noble Forrest W. & Timothy M. Cooper, 2014, http://www.pantheory.org/HF.htm, accessed 21.08.2018).

5.4.4 Summary

Using the trial and error method for interval calibration, as we said, it was possible to separate the interval of redshifts into three extents. Based on our knowledge that for the Vacuum (Dark) Ages the absorbtion density was $>> 0$ and for the Current Phase of the Universe the absorbtion coefficient equals $\kappa = 0.12457$ we succeeded in a rather satisfactory way.

6. RESULTS

Our contemporary knowledge of the structure of the Universe extends to galaxies and quasars, which form groups and clusters of various categories of extragalactic objects. The entire Cosmos is permeated with radiation comprising of the infrared, visible, ultraviolet and X-ray radiation emitted by extragalactic objects, as well as neutrino fluxes. It also includes relict microwave and neutrino radiation, the occurrence of which is purported to be associated with the *Big-Bang* event that initiated the emergence or grows of the Universe.

The complexity of the Universe, which we are trying to understand, and whose visual particles we strive to control, inevitably results in difficulties in attempting to represent observations in the field of astronomy in a form that is understandable to a mathematician. We hope that our mathematical modeling succeeded in overcoming such challenges, as it permits similar language to be adopted by both the observer and the theoretical physicist. In creating this connection, we relied on the energy absorbtion κ coefficient, developed in the previous section, which replaces the events in static space by gravitons of vector-field energy dynamics of the Universe. It nonetheless explicates the distribution of matter and energy in the Universe that is acceptable to both mathematicians and physicists.

The energy absorbtion scale κ remains merely of theoretical value in spite of confirmation of the scale obtained by solving Γ-equation, for which we utilized the data sourced from NED distances in the form given by Table 2; cf. Astronomical Journal, 153:37, 20 pp. (Steer et al. 2017). On the other hand, the scale κ explaining the dynamics of the Universe in alternative terms related to extragalactic objects can be interpreted as evidence supporting the reliability of our mathematical model, rather than pointing to its inconsistency.

6.1 NED Data

For the comparative analysis, in line with the approaches described in known literary sources, cosmic distances are traditionally calculated using: relativistic Doppler Effect formula with the Hubble constant H_0 or the formula for modulus $m - M$. However, Noble et al. distance, http://www.pantheory.org/HF.htm (accessed 21.08.2018) is different. It is noteworthy that in Table 2 by specifying the redshift z the distance to a cosmological object allows to be expressed in megaparsecs, also known as the MpC distance. It signifies the position to which the object should be repositioned in order to see it at an angle of 1″ second from the protozoan points of the Earth's orbit around the Sun.

Table 2: Intergalactic estimates: Representatives of Galaxies	**Equation**	**Hubble**	**F. Noble**	**M-Distance**	**Mean m - M**	**NED (MpC)**	**Window**
MACS J0647.7+7015	**9643.0**	**4046.1**	**25338.4**	**46410.6**	**47.8104**	**7415.3**	Win1
GRB 060210	**8897.1**	**3851.2**	**16999.0**	**29795.2**	**47.1553**	**6680.1**	Win2
GRB 060526	**8418.4**	**3768.6**	**14351.3**	**19561.4**	**45.9457**	**4946.3**	Win3
GRB 030429	**7799.9**	**3595.7**	**11917.0**	**20218.6**	**46.3504**	**5649.6**	Win4
[HB89] 2345+000:BX0120	**7326.2**	**3440.8**	**10468.6**	**16720.6**	**45.7164**	**4350.7**	Win5
GRB 030226	**6489.0**	**3228.8**	**8426.9**	**12372.6**	**45.1692**	**4465.3**	Win6
COMBO-17 19434	**5895.5**	**3093.4**	**7244.9**	**9358.4**	**44.6939**	**3568.7**	Win7
COMBO-17 40328	**5455.3**	**3053.1**	**6468.1**	**9351.9**	**44.7727**	**4036.4**	Win8
COMBO-17 35663	**5232.3**	**2949.9**	**6100.8**	**9031.7**	**44.6779**	**3957.9**	Win9
SCP 06R12	**4798.6**	**2769.1**	**5430.5**	**7450.9**	**44.2321**	**3476.1**	Win10
GRB 000911	**4469.3**	**2683.1**	**4954.9**	**6561.9**	**43.9983**	**3225.9**	Win11
GSS 074_5532	**4325.7**	**2629.8**	**4755.4**	**8202.0**	**44.2812**	**3836.4**	Win12
[RSC2007] J123809.00+621847	**4246.1**	**2601.4**	**4646.9**	**6592.2**	**44.0283**	**3295.2**	Win13
XSS J18076+5937	**4195.1**	**2601.8**	**4578.1**	**5980.3**	**43.8316**	**3053.7**	Win14
GRB 071010B	**4132.7**	**2551.1**	**4494.6**	**5828.2**	**43.7528**	**3013.9**	Win15

CGCG 266-031	**98.2**	**102.1**	**107.9**	**104.5**	**35.0596**	**102.0**	Win184
UGC 11064	**96.0**	**100.4**	**105.2**	**144.4**	**35.3321**	**103.7**	Win185
ESO 573- G 014	**93.5**	**97.6**	**102.3**	**114.8**	**35.0979**	**112.2**	Win186
NGC 0232	**90.0**	**92.9**	**98.0**	**104.9**	**34.9671**	**96.0**	Win187
UGC 06363	**86.2**	**88.9**	**93.4**	**169.5**	**35.0541**	**92.1**	Win188
ESO 300- G 009	**82.8**	**85.1**	**89.3**	**90.6**	**34.7375**	**88.7**	Win189
NGC 3332	**79.4**	**81.0**	**85.1**	**107.3**	**34.7433**	**82.6**	Win190
NGC 3873	**75.6**	**77.4**	**80.5**	**72.6**	**34.2727**	**71.3**	Win191
UGC 00052	**74.3**	**75.3**	**78.9**	**71.8**	**34.2273**	**70.6**	Win192
ESO 478- G 006	**71.4**	**71.0**	**75.2**	**73.8**	**34.3151**	**72.5**	Win193
NGC 5490	**68.5**	**68.2**	**71.7**	**78.0**	**34.2991**	**68.7**	Win194
CGCG 141-044	**67.0**	**66.0**	**69.8**	**70.5**	**34.1464**	**69.4**	Win195
NGC 4495	**65.7**	**65.0**	**68.1**	**64.2**	**34.0064**	**63.1**	Win196
UGCA 036	**63.7**	**62.4**	**65.7**	**64.4**	**33.9964**	**63.5**	Win197
CGCG 308-009	**61.9**	**60.1**	**63.3**	**64.5**	**34.0033**	**63.5**	Win198
NGC 2258	**58.4**	**56.0**	**58.9**	**59.0**	**33.8212**	**58.2**	Win199
NGC 7408	**46.8**	**47.6**	**50.4**	**49.0**	**33.4045**	**47.1**	Win200

The data in Table 2 is collected on the basis of individual cosmological objects from NED sources. As far as we know, the NED database is provided by long-term observations conducted by astronomers, institutions, individual research groups, or private organizations interested in space depth research. The distances and the modulus are of interest for evaluating and comparing the theoretical methods. However, this still does not alleviate the bewildering and perplexing problems related to calculating distances to cosmological objects. According to NED, for galaxies or stars the distances are measured independently of redshifts. However, it seems to us that m – M modulus have been frequently used for this purpose, probably due to the challenges related to conducting independent measurements at the distant parts of the Universe.

When moving along the 15.000 lines in the MS *EXCEL* spreadsheet, the mean and median values of averages for 200 windows were calculated. Each window consists of 75 supernova records. Comparative results of distances are presented in Table 2. The entire table is available on request. We have chosen these windows for some technical reasons connected to MathCAD 5.0, which allows vector variables at most only with 200 components to solve equations by iteration method.

For comparison, an index of distance +over/−under estimates for these 200 windows was developed. To produce a normalized index, we divided average distances D_i obtained by a particular method by the average NED distance N_i in Mean (MpC) column and then subtracted one. The indices $\left(\frac{D_i}{N_i}-1\right)$, $i=\overline{1...200}$, of +over/−under estimates reflects the situation in Table 3 like a series of experiments have been conducted to determine whether the distances D_i are closer or further than the N_i distance shows. If the experiment shows a different results (more or less) equal number of times (closer or further), then it is considered that D_i is approximately balanced with an expected distance N_i. If it, also, almost always turns out that objects on trial are closer than (or farther than) N_i, then it is considered that the D_i distance, in contrast, is misbalanced with N_i.

It became clear for some astronomers, who postulate a link between intergalactic distance and the extent of redshift, observing the Universe on the basis of Hubble's law, that the calculations using the relativistic Doppler formula are not entirely correct. In order to examine this issue more closely, we calculated the mean and median +over/−under estimates of distances collected into Table 3 taken from 15.000 supernova records in NED database. Based on the information sourced from the database, using some H_0, we compared methods typically employed when calculating distances between the objects in the Universe. In Table 3, the Γ-equation column presents distances based on the μ scale, which we denoted as the energy absorbtion scale of space and matter.

Table 3: Total Observation	Γ-equation	Hubble	Noble	Modulus
Disbalance z>0.594	**29.4%**	**-21.7%**	**54.2%**	**121.1%**
Median z>0.594	**24.1%**	**-20.8%**	**31.2%**	**84.0%**
Deviation	0.14	0.07	0.51	0.98
Disbalance 0.594>=z>0.2178	**0.4%**	**-22.3%**	**1.7%**	**38.4%**
Median 0.594>=z>0.2178	**0.0%**	**-22.3%**	**1.7%**	**35.3%**
Deviation	0.09	0.07	0.10	0.18
Disbalance z<=0.2178	**0.8%**	**0.1%**	**5.3%**	**3.1%**
Median z<=0.2178	**0.1%**	**-1.3%**	**4.1%**	**1.7%**
Deviation	0.03	0.05	0.05	0.04

Closer scrutiny of the data presented in Table 3 reveals that, at lower, perhaps moderate, redshift values, i.e., for $0.594 \geq z > 0.2178$, there is reasonable agreement between the Γ-equation and Noble F. formula for the distances to cosmological objects. The quality of the computed distances is also compared by the alignment with the Doppler formula. However, for higher redshifts, i.e., for $z > 0.594$, discrepancies for Γ-equation with Doppler formula are evident, as well as in relation to the Modulus and the results based on the Noble et al. theory both together. Although Noble F., and Modulus seems to overestimate independent distances, the Γ-equation provides similar overestimates for greater redshifts. In addition, according to the Doppler Effect calculations based on the Hubble constants chosen from the range starting at 66.375 up to 70, the discrepancies of underestimates exist both at moderate and higher redshifts. Indeed, Hubble's law produces obvious underestimation for both of these indicated extents of redshifts. However, according to Table 3, for the redshift values $z \leq 0.2178$ pertaining to the cosmological objects "*in the vicinity*", the Γ-equation predicted approx. the same magnitude of estimates relative to those yielded by luminosity distances. This prediction for galaxies in the nearest vicinity, as already noted, is often based that in the NED Database the estimates relay on modulus distance formula.

6.2 A Posteriors Experiment

The formulas of Hubble's law relativistic Doppler Effect in comparison to Γ-equation, are shown, F. Noble and Modulus distances, on Figure 4 — both in their original form and in a more elegant form.

Hubble Distance **Pan Distance** $c = 299792.458$ **speed of light** $H_0 = 66.375$

$$\frac{(1+z)^2 - 1}{(1+z)^2 + 1}\cdot\frac{c}{H_0} \qquad 21.2946\cdot\log\left[\frac{1}{2}\cdot\left[\left(\sqrt{1+z}\right) - 1\right] + 1\right]\cdot\left(\sqrt{1+z}\right)\cdot 1958.3$$

Modulus distance MpC

$$\tanh(\ln(1+z))\cdot\frac{c}{H_0} \qquad 18110.607641\cdot\ln\left[\left(\frac{1+\sqrt{1+z}}{2}\right)^{\sqrt{1+z}}\right] \qquad dist = \frac{10^{1+\frac{m-M}{5}}}{10^6}$$

Figure 4: The formulas for calculating distances to Cosmological Objects according to the methods known to the author of the study. The results yielded by applying these formulas are transferred into Table 4.

Table 4: For any astronomer, including amateurs, it will be easy to check our results if one tries to access the NED, https://ned.ipac.caltech.edu/forms/byname.html (accessed 12/19/2018), where one can find the redshift values for some extraterrestrial objects.

Γ-Eq.	Hubble	Noble	Modulus	Redshift	Extraterrestrial object
2171.9	1498.8	2197.6	2523.5	0.466082	3C 411
1701.3	1241.1	1715.1	1386.8	0.366090	3C 048
9237.2	3796.6	19714.9	24774.2	4.047950	GRB 060206
6697.3	3188.7	8887.9	13614.4	1.819000	3C 256
704.9	603.3	734.8	734.5	0.159492	3C 273
112.7	111.4	125.0	115.3	0.027514	NGC 4860
6057.2	3011.6	7550.3	11117.3	1.549480	GRB 051111
923.2	756.7	947.9	809.1	0.204885	LEDA 25177
103.7	102.2	114.4	102.8	0.025199	ARP 334
26.3	22.0	24.4	22.2	0.005380	ARP 152
24.9	20.1	22.2	16.4	0.004907	ARP 159
32.3	30.0	33.2	30.3	0.007331	NGC 0772
5218.3	2755.3	6078.4	8550.7	1.253328	GRB 020813
37.0	36.1	40.1	38.0	0.008836	NGC 3516
8.2	6.1	6.8	8.4	0.001491	NGC 5832
4151.6	2381.4	4519.9	5970.4	0.939227	AO 0235+164
3.1	3.3	3.6	6.7	0.000804	MESSIER 101
576.0	507.7	608.0	542.0	0.132313	LEDA 51975
78.5	75.4	84.1	77.3	0.018529	ARP 220
1.9	1.2	1.3	1.2	0.000297	NGC 4569
73.2	69.6	77.5	66.7	0.017085	3C 449
107.5	106.1	118.9	66.7	0.026175	NGC 7385
495.3	445.5	527.8	515.2	0.115068	PKS 2155-304
24.0	18.9	20.9	16.5	0.004622	NGC 4487
101.4	99.8	111.7	16.5	0.024601	NGC 1265
328.5	309.9	358.9	342.0	0.078548	IC 1101
6022.5	3001.6	7483.7	11015.4	1.536089	SDSS J1156+1911
138.0	136.9	154.1	137.4	0.033903	ESO 325- G 004
69.2	65.1	72.5	66.4	0.015980	ABELL 3627
71.1	67.2	74.9	67.0	0.016506	2MASS J04375556-0931094
52.5	46.2	51.3	46.8	0.011313	NGC 7714
95.2	93.3	104.3	95.9	0.022980	UGC 00014
9855.2	3980.4	33262.1	68548.8	7.000383	EGS-zs8-1
38.6	38.1	42.3	28.2	0.009330	NGC 7619
43.9	44.9	49.8	45.5	0.010988	NGC 5010
7414.9	3371.7	10720.3	17139.6	2.189613	UDFj 39546284
126.0	124.9	140.4	130.0	0.030893	Markarian 421
26.3	22.0	24.4	22.2	0.005380	NGC4486
31.1	28.4	31.4	28.7	0.006940	LEDA 36252
111.3	109.9	123.3	113.8	0.027140	PGC 6240

9444.0	**3848.2**	**22067.6**	**3848.2**	**4.546953**	Baby Boom
823.7	**688.0**	**850.9**	**863.0**	**0.184268**	ABELL 1689
1474.7	**1108.4**	**1488.8**	**1606.9**	**0.318843**	ABELL 1995
3198.2	**1991.8**	**3330.3**	**4130.5**	**0.698091**	MACS J0744.9+3927
1520.1	**1135.5**	**1533.9**	**1667.2**	**0.328288**	ZwCl 1358.1+6245
61.1	**56.1**	**62.3**	**57.0**	**0.013746**	Hydra Cluster
4293.8	**2434.8**	**4711.9**	**3597.5**	**0.978000**	SN 2001jm
2635.1	**1732.0**	**2693.2**	**3062.0**	**0.568000**	SN 2001iy
6054.1	**3010.7**	**7544.2**	**11117.3**	**1.548267**	HG 051111
23.0	**17.6**	**19.4**	**16.8**	**0.004283**	MESSIER 87
30.2	**27.2**	**30.2**	**27.5**	**0.006658**	ARP 274
110.56	**109.2**	**122.46**	**124.7**	**0.026959**	NGC 4039
9100.4	**3764.0**	**18499.1**	**33265.9**	**3.792285**	N4C 41+41.17
54.1	**48.1**	**53.4**	**45.5**	**0.011778**	ARP 333
9776.5	**3943.7**	**28892.1**	**5495.4**	**6,027000**	ABELL 383
22.6	**16.93**	**18.7**	**11.8**	**0.004130**	ESO 162G017
7255.1	**3332.2**	**10273.2**	**16218.1**	**2.099000**	4C +01.02
7470.4	**3385.2**	**10881.8**	**17458.2**	**2.222364**	PKS 0237-23
9402.6	**3837.5**	**21530.0**	**16069.4**	**4.432400**	PSS J0747+4434
7895.6	**3486.9**	**12246.7**	**10280.2**	**2.500000**	B3 0727+409
9765.1	**3943.2**	**28842.2**	**24660.4**	**6.016000**	SDSS J1306+0356
1369.3	**1044.5**	**1384.5**	**1224.6**	**0.297000**	H 1821+643
9882.6	**3994.8**	**35505.5**	**31915.4**	**7.507800**	z8 GND 5296
9907.3	**4010.8**	**38529.5**	**17298.2**	**8.200000**	GRB 090423
9942.1	**4050.9**	**50744.0**	**50118.7**	**11.09000**	GN-z11
25.0	**20.2**	**22.4**	**20.3**	**0.004937**	NGC3227
76.1	**72.5**	**81.1**	**74.5**	**0.017877**	NGC5548
2745.0	**1784.6**	**2814.3**	**2432.2**	**0.592800**	3C 345
9886.6	**3997.2**	**35915.4**	**31188.9**	**7.601068**	ABELL 1689-zD1
9926.1	**4027.2**	**42444.3**	**40738.0**	**9.110000**	MACS1149-JD1

6.3 Summary

Summing up all our efforts presented in this study, we can conclude that the distances calculated in accordance with the Hubble's law are the most severely underestimated in almost entire spectrum of red-shifts. On the other hand, the deviations created by the Noble F. are an order of magnitude higher overestimates the greater are the redshift values even if they match quite satisfactory the NED Database for lower values. When measuring distances using the modulus for estimating luminosity distances, the largest deviations, even grater than Noble F., occur in the spectrum of high redshifts.

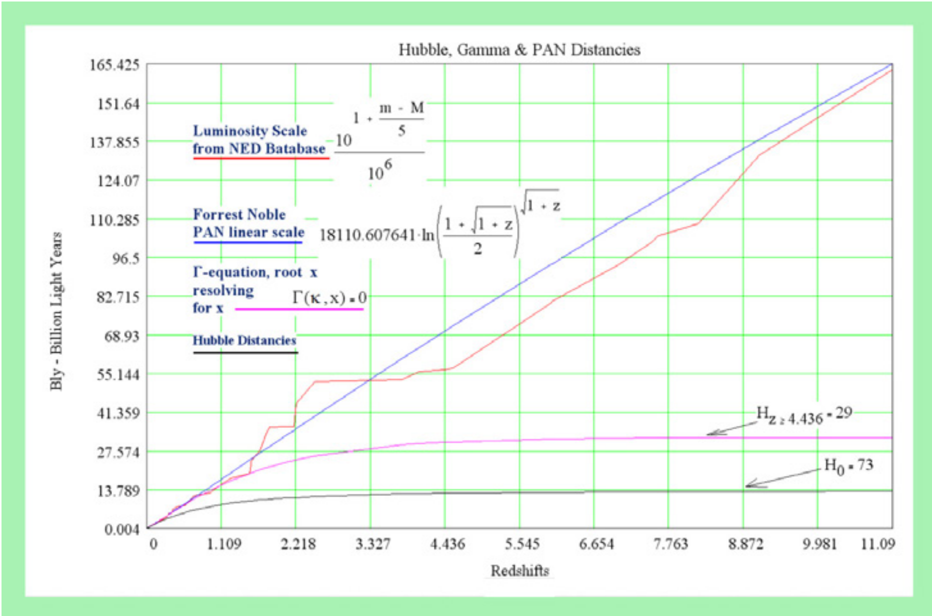


Figure 5: Based on cosmological redshifts z and modulus m – M obtained from NED database. It is an image of the comparative analysis of distances calculated to cosmological objects on the basis of the formulas given above and Γ-equation procedure. The Luminosity, Noble F., Γ-eq., NED and Hubble traces are calculated using Table 2. Substituting into the Noble formula $z = 1$, the distances are approximately consistent with the linear law: $\text{Linear Pan Formula}(z = 1) \cdot z$.

It should be noted that the estimates obtained using the Γ-equation are more reasonable in the spectrum of moderate redshifts than the estimates obtained by all other methods. The observation of the position of the Γ-equation estimates on the Figure 5 amid Noble F., and NED Database distances, also with regard luminosity distance, indicates for us that the size of the universe does not correspond well enough to the Hubble's law. If we take into account the reasonableness of our mathematical model in this study the Universe seems for us to be also much larger in size than it is commonly believed. Such a discrepancy in the estimates may well be due to the fact that the luminosity of distant cosmological objects is much stronger than expected, and these distant objects emit, perhaps, much more energy. It is also noteworthy to emphasize that using the NED database it was possible to fine tune calculations and establish the most accurate estimates of the distances to cosmological objects by the Γ-equation. The tuning was achieved by dividing the redshifts interval into three extents introducing three average absorbtion functions of κ separately in each extent as noted above.

In conclusion, it is also necessary to make, as we think, one important comment. We have repeatedly pointed to the Hubble's constant that this is not a constant at all, but most likely, a Hubble's variable H_0. If our thoughtful reader turns attention to the trace calculated by the rules of the Γ-equation, then one can see that this trace in Figure 5 is very similar to the Hubble's distances somewhere starting with the redshift values in the region higher than $z \approx 4.436$. The Hubble's trace occupy a shifted area along the y-axis but down by some interval. Now it is not difficult to figure out what will be the shift interval along the y-axis, which can match the Γ-equation trace into Hubble's trace by changing the constant H_0 for calculating distances using the formula:

$$\frac{(1+z)^2-1}{(1+z)^2+1}\cdot\frac{c}{H_0} \equiv \mathrm{tangh}(\ln(1+z))\cdot\frac{c}{H_0}.$$

Indeed, the current value of $H_0 = 73$, and c is the speed of light—the value 73 is taken from NED database. If we now replace the constant H_0 by $H_{z\geq 4.436} = 29$ (remembering that this is not a constant at all), then it turns out that the Hubble distance trace will very accurately fit our trace calculated according to the rules of the Γ-equation. However, we must separate the entire space of galaxies—if we may say so—into two regions—the so-called foreground galaxies with the red shift number with the boundary number no more than 4.436, and the background galaxies with the redshift number greater than 4.436. The indicated shift by 29 is valid only for background galaxies with a redshift of more than 4.436 and from which the light has reached us from the distant past. Now, again, it is not difficult to understand that if we take the number 29 for the Hubble's constant, then it will be a constant, which supposedly was in the distant past and which tells us, presumably, that in the distant past the growth of the Universe occurred more than two times slower than now.

From the foregoing, it is quite obvious to conclude that it is also fully consistent with Figure 2, that in the modern era, according to the forecast calculated according to the rules of the Γ-equation, in the future our universe will catch new areas of background energy field W faster and faster. Everything that has been said here (we have already indicated this circumstance where it was appropriate) agrees with the fact that the size of our universe not only increases, but this growth also occurs with acceleration. As the dynamics of acceleration shows, in accordance with the Γ-equation—the **Γ**-trace in the past—the growth of the Universe, as well as the acceleration, both have been practically insignificant. Indeed, for large values of redshift in the displacement of distances along the y axis, the **Γ**-trace is almost parallel to the x axis of the redshift.

It is also appropriate to emphasize here that the Γ-equation is derived from the postulate of the graviton transition of energy-field into quantum vacuum and baryonic matter. Therefore, the growth of the Universe by the rules of the Γ-equation is not an expansion in the sense of the standard cosmological model, i.e., the Big Bang model, but a certain "space capture" of the backgound vector-field due to the narrowing of the energy-field region. That is, here we are dealing with a universe where the baryonic matter inside the universe is stable and does not move anywhere in contrast to what the Big Bang model supposedly predicts. So, the Γ-equation highlights the steady state Universe.

7. DISCUSSION

The aim of this investigation was to provide a reliable way for estimating cosmological distances. In our analysis, we started with the Space idealization assuming homogeneity and isotropy of the space; the so-called Copernican Principle was supposed to be valid. Isotropy implies absence of allocated directions (top, bottom and others), thereby postulating independence of the properties of bodies moving by inertia from the direction of their motion. Complete isotropy is inherent only in vacuum, as anisotropy in the distribution of the binding forces characterizes the structure of real bodies. They split in some directions better than in others if we observe the Universe in grid gravitons of 50-100 MpC in dimensions. In the same way, complete homogeneity, characteristic only of an abstract Euclidean space, is an idealization. The real space of material systems is inhomogeneous, as it differs in the metric and in the values of curvature, depending on the distribution of gravitating forces.

Recent observations from the James Webb Space Telescope (JWST) have sparked discussions within the scientific community about possible violations of the Copernican Principle, which asserts that Earth and its inhabitants do not occupy a special or central position in the universe. Indeed, some interpretations of JWST data, particularly concerning the distribution and formation of early galaxies, have raised questions. JWST has observed galaxies that appear more mature and massive at much earlier stages of the universe than current models predict. This could imply that either our understanding of galaxy formation and evolution needs revision, or there could be more profound implications for the large-scale structure of the universe.

Some researchers have pointed out that if these observations are confirmed and cannot be reconciled with existing models, it might suggest a departure from the assumption that the universe is uniform and isotropic, potentially challenging the Copernican Principle. Nevertheless, these are still early interpretations, and further analysis and observations will be crucial to determine whether these findings represent a true violation or if alternative explanations can account for the unexpected data.

Often, numerous anomalies and paradoxes in cosmology suggest that, in the context of the Universe's dynamics, it is reasonable for cosmologists to consider an average scale of energy absorption, thereby rejecting the homogeneity of space while maintaining the assumption of isotropy. However, given our postulate of a gravitational transition leading to the space capture, the inhomogeneity of the quantum vacuum and baryonic matter in space should manifest itself, showing a decrease in gravitons' energy absorption as the growth phenomena in the visible hemisphere develop. This speculative postulate, despite violating the Copernican principle of homogeneity, can lead to a correct understanding of the dynamics of space and matter in the depths of space, provided the distance to an observed extragalactic object is accurately estimated based on the light emitted in the past. By including the principle of gravitational transition of the energy field in space dynamics, we believe we can achieve a complete picture of the Universe.

This approach could reconcile many cosmological observations and theoretical predictions, shedding light on the underlying mechanics of cosmic space capture and particle formation. The phase transition of gravitons into real particles at certain energy thresholds might explain the genesis of matter and the large-scale structure of the cosmos. Moreover, the inherent inhomogeneity predicted by our model could account for observed variations in the cosmic microwave background radiation and the distribution of galaxies.

In the context described above, when attempting to verify the correctness of a newly developed theory, a researcher should also take into account the reliability of the data used. In some cases, the theory can be verified by examining it through its own prism—a common strategy when observing the reality. This is not the case here, because the reliability of the data records reported by NED is not in doubt. On the other hand, if there were no high correlations between known methods for calculating distances, e.g. between the modulus or the alternative theory of Noble F., and if there was a clear degree of contradiction with respect to the Hubble's law, a comparative analysis of average absorbtion scale κ of energy vector-field will not be worth the efforts—it will end where it started. The only objection that really matters is that we interpreted the data on the basis of the energy absorbtion scale κ using the hypothesis of graviton transition of the energy-field into quantum vacuum and baryonic matter while the energy absorbtion κ decreases with the evolution of the Universe. The transition hypothesis cannot be adequately confirmed without accepting the validity of the graviton transition of energy-field on the basis observations. It is also clear that we are not in the position to provide evidence in support of this assertion.

8. CONCLUDING REMARKS

In this study, we presented a speculative equation describing the space and matter composition at the point of emergence from energy-field and as it continues to emerge. Calibrating the equation in accordance with the current mass-energy composition of the Universe allowed us to reach some speculative conclusions with regard to the energy dynamics in the Universe. We suggested treating the Big Bang as a sudden occurrence of freezing graviton energy, or any other known or unknown type of energy, releasing latent heat. While this was a plausible line of reasoning, the math that can describe this process allowed us to explain the current composition of the Universe.

None of our speculations presented here fundamentally contradicts the latest views on the composition of the Universe in terms of the percentages of quantum vacuum and baryonic matter in proportion to the energy-field. Specifically, contradictions are avoided due to the calibration and by imposing the curvature relationship. Obviously, we eliminated the mathematical impossibility of Big Bang singularity problem of cosmic growth of the geometry from an alleged singularity $r \approx 0$. Instead, we focused on a series of holes/bobbles, represented as hyper-manifolds $\boldsymbol{S}^3(r)$ of radius $0 \le r \le 1$ enclosing the $\boldsymbol{\mathcal{R}}^4$ hyper-globe by adopting radius of space curvature equal to 1. The latter eliminated any ambiguity in the outcomes pertaining to the quantum vacuum and baryonic matter fractions in proportion to the energy-field in case that the grid incorporated graviton absorbation constant κ/μ into potential energy measurements, i.e., the case when the grid guarantees the correct output irrespective of the values adopted for κ/μ.

We were interested in the composition of quantum vacuum, baryonic matter and energy-field, wherever these three components might be in reality. Subsuming the $\frac{\kappa}{\mu} = \text{const}$ results also in that our Γ-equation is transparent to the curvature of the space. That was the motivation behind the choice of curvature $\text{const} = 1$. Our speculative equation required fine-tuning or calibration of the so-called Λ-parameter of a speculative space-energy graviton transition level, as well as the λ-parameter characterizing a modified potential energy-field. This allowed the optimal values to be determined, with respect to achieving the best tuning effect posited by the Planck Mission. Thus, the search for the roots of the equation depending on the absorbtion of coefficient κ can have some predictive power, since the relative location of the root values in the current κ is almost 100% consistent with the latest Planck Mission Statement about the composition of space and matter in the Universe.

The next important assumption pertained to the absorbtion density coefficient κ of the emerging space and matter, to which we referred as an absorbtion density. While acknowledging that the explanation offered for the NED data analysis findings requires more convincing arguments of equivalence of energy and space, we proceeded with our analyses by assuming that the absorbtion density was aligned with the "*normal density*" of matter. The concept of density allowed us to interpret, as well as predict, the dynamics and "*quasi-velocity*" of the formation of a hole or a globe within space. It was also possible to make assertions that essentially coincide with the NASA statement that, in the past, the S^3 manifold captured new space more slowly than it does presently. As our manifold implies, only a tiny globe of quantum vacuum solves the equation at the higher end of the absorbtion density scale. At this extreme end of the density scale, the manifold comprised solely of energy-field, i.e., when the time $t \leq 0$ since the baryonic matter radius suggested almost a zero solution. At the opposite (lower) extreme of the scale, approaching the critical value, in contrast to the baryonic matter, the quantum vacuum will allegedly start to diminish.

APPENDIX. The absorbtion density scale effects

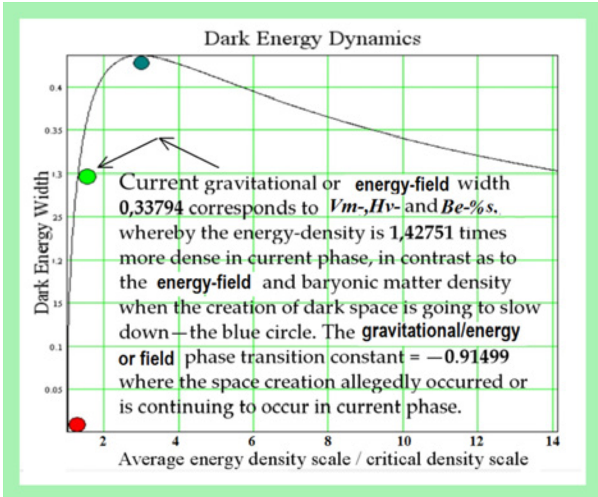
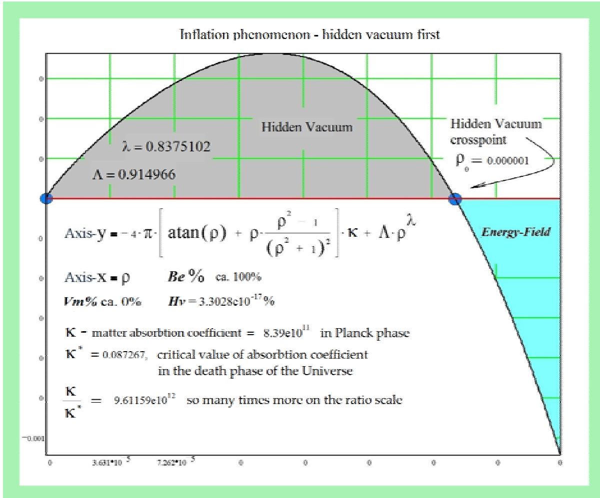


Figure 6: Shows the dynamics of energy-field as a function of density.

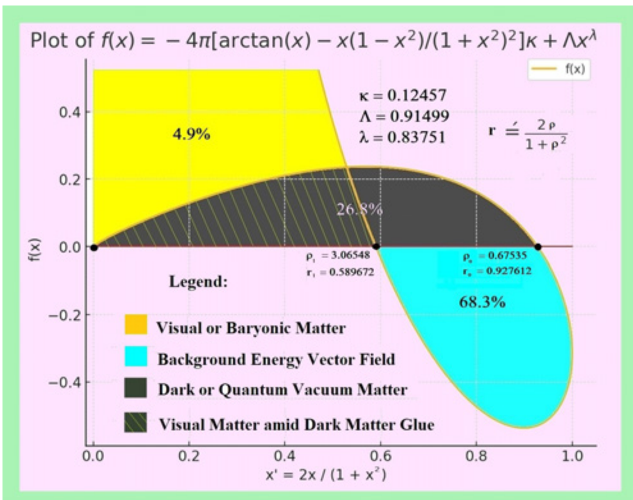
The scale of absorbtion density on the x-axis extends from its critical ratio=1 and will continue to reflect the energy-field width as it shifts to the right. If one moves in the opposite direction (to the left), using the analogy implied by the proposed scale, the Figure 6 shows that the formation of quantum vacuum or matter precedes, cf. Carroll (2007), that of baryonic matter because the gap between the two forms increases. On the y-axis, when the inverse stereographical distance $r_1 - r_0 = 2 \cdot \left(\frac{\rho_1}{1+\rho_1^2} - \frac{\rho_0}{1+\rho_0^2} \right)$ reaches some point, it will stop increasing, thus closing the aforementioned gap. The reduction, as indicated in Figure 6, will be most pronounced in the absorbtion density in vicinity of 1, where the red circle indicates the end of the evolution of the manifold—the moment of reaching the absorbtion critical level κ^*. Thus, as indicated by the blue circle, at the much later stages of evolution, the gap between the baryonic matter and the quantum vacuum starts to close. The state of the manifold at the current stage—denoted by the green circle—is particularly relevant here, as it indicates the present state of the manifold that has already passed the turnaround point. When the gap started closing, the absorbtion density was about three times greater than that at the present state.

Figure 7: Depicts the case of absorbtion density exceeding a critical value $\kappa^* \approx 0.087267$ by more than $\approx 9.6115916 \cdot 10^{12}$ times. Quantum vacuum size $\rho_0 \approx 0.000001$



Based on the zero solution $\rho_s \approx 0 > 0$ of the equation, while moving to the right along the x-axis, the speculation states that a positive root $\rho_0 > 0$ can be interpreted as a creation of a small lump of quantum vacuum. We can paraphrase this statement, positing that the quantum vacuum was created first. As it preceded the baryonic matter creation—the inflation Bang of the Big Bang resulted in the emergence of the quantum vacuum only.

Figure 8: Two roots on opposite poles of S^3 geometry/bubble



The graphical illustration provided in Figure 8, denoting the link between the S^3 manifold and its stereographical projection into Euclidian topology $\mathscr{E}^3$ inflated by quantum vacuum and baryonic matter with regard to energy-field, is the foundation for the study of the essence of all of our Speculations. On the x-axis, the radius r is given by an inverse stereographic mapping $r = \frac{2\rho}{1+\rho^2}$ while the y-axis corresponds to

$$\Gamma(\kappa,\rho) = -4\pi \cdot \left(\tan^{-1}(\rho) + \rho \cdot \frac{-1+\rho^2}{(1+\rho^2)^2} \right) \cdot \kappa + \Lambda \cdot \rho^{\lambda}.$$

The interval $[0 \le \rho \le 1]$ in r-coordinates corresponds to $[0 \le r \le 1]$, whereby the coordinate $r \to 0$ when moving further from 1 corresponds to $\rho \to \infty$. Thus, in the r-coordinate system used in Figure 8, presence of *double curves* on the x/y-axis for $\Gamma(\kappa,\rho)$ makes sense.

Two roots (ρ_0, ρ_1) at which the formation of space and matter allegedly occurs solve the equation $\Gamma(\kappa,\rho) = 0$. Hence, it can be seen that the graph shown in Figure 8 corresponds to the absorbtion density $\kappa = 0.12457$ supposedly representing the current state of the manifold S^3. While passing through the area highlighted in gray, we move r_0 from zero point $0 \to r_0$. In the ρ coordinate system increasing the ρ_0 upward: $0 \to \rho_0$, we are moving along the positive portion of $\Gamma(\mu,\rho)$, which corresponds to 26.8% of quantum vacuum in the Universe composition. Positive $\Gamma(\kappa,\rho)$ values indicate the region in the manifold S^3 where the alleged formation of quantum vacuum and baryonic matter already occurred. Similarly, entering the region $\Gamma(\kappa,\rho)$ denoting negative values (depicted in blue), we move through the energy-field, which accounts for about 68.3% of the total energy, and is sufficient for further evolution of the manifold. Reaching the radius r_1, we enter the region of baryonic matter, contributing about 4.9% to the Universe composition and moving away from $\rho_1 \le \rho \to \infty$. As depicted in Figure 8, at the radius r_1 and beyond, baryonic matter cannot be in contact with the energy-field in the coordinate system $\rho \in (0, \rho_1)$. However, as it can be seen, it is superimposed on the quantum vacuum at $0 \le r_1$. In conclusion, the scenario depicted in this Figure 8 should be understood as an attempt to visualize the current state in calibrating of the Universe according to the latest data yielded by the Planck Mission measurements.[ii]

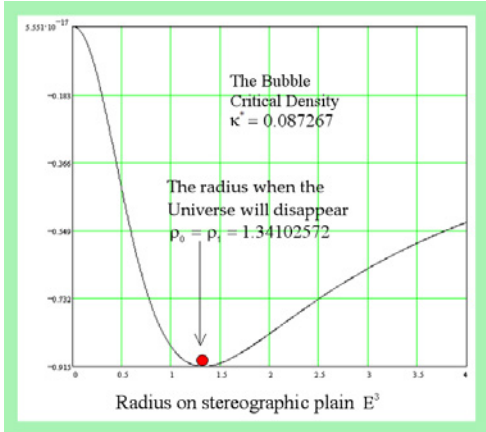


Figure 9: The potential energy governed by the radius starting at point 0.

The case presented by the graph shows on the x-axis in the respective coordinate system ρ our speculative Γ-equation of space and matter creation allowed only a single root, $\rho_0 = \rho_1$. This is the *moment* after which the evolution of the manifold supposedly ceases, since the formation of the new space and matter will terminate upon reaching the absorbtion critical level κ^*. At this last *energy-moment*, when the radius $\rho_0 = \rho_1 = 1.34102572$, as indicated by the solution of our Γ-equation, the absorbtion density in the manifold will be critical, $\kappa^* \approx 0.087267$. The manifold in its current state is characterized by density $\kappa = 0.12457$, which is, as already pointed above, 1.42751 times greater than the absorbtion critical level at the scale κ with regard to the level at the starting point κ^*. The value κ^* of critical absorbtion potential energy is depicted on the y-axis in Figure 9. In this graph, $V.S^3(\rho)$, equal to the volume of a manifold $S^3(\rho)$ of radius ρ, is multiplied be the critical level κ^* at which the potential energy of vector-field with respect to the absorbtion critical level—i.e., the level when only a single root of the Γ-equation exists.

Note that the manifold given by Γ-equation, in contrast to that usually adopted does not contain the time scale coordinate. Instead, we used the absorbtion density coefficient κ, which declines from very high values that are $96{,}115 \cdot 10^{11}$ times greater than κ. Then we attempt to shift the density towards the critical value $\kappa^* \approx 0.087267$. Replacing the evolution of the manifold given by Γ-equation by the absorbtion density κ coefficient is an exercise, due to the scale of *densities*, where declining values replicate the dynamics of space and matter creation within the manifold. Our exercise indicates that the density μ declines towards the current mass-energy composition; it accounts for the κ value pertaining to the current composition, which is at least 1.42751 times denser than $\kappa^{*} \approx 0.087267$.

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[i] **Historical Background**

1. **Le Sage's Theory (18th Century):**
   - **Concept:** Le Sage proposed that gravity could be explained by a flux of tiny, unseen particles (sometimes called "corpuscles") that permeate space. According to the theory, these particles are constantly moving in all directions and exert pressure on objects. When two objects are near each other, they shield each other from the flux, leading to a net force pushing them together. This was Le Sage's explanation for gravitational attraction.
   - **Mechanism:** The key idea is that the shadowing effect caused by objects blocking the particles leads to a decrease in pressure between the objects compared to the pressure on their outer sides, thus pushing them together—hence, "pushing gravity."
2. **19th and 20th Centuries:**
   - **Criticism:** Le Sage's theory faced significant challenges, particularly regarding the energy requirements and the implications for thermodynamics. One of the main criticisms was that the continual bombardment by these particles would cause objects to heat up over time, which is not observed. Additionally, the theory would require a colossal amount of energy to maintain the flux of particles, raising questions about the source and sustainability of this energy.
   - **Decline in Popularity:** With the development of Newtonian gravity and, later, Einstein's general theory of relativity, which provided a more comprehensive and mathematically rigorous explanation for gravitational phenomena, Le Sage's theory fell out of favor.

Modern and Future Developments

1. **Interest in Alternative Theories:**
   - **Renewed Attention:** Despite its decline, the concept of "pushing gravity" has seen sporadic interest in certain scientific circles, especially among those exploring alternative explanations for gravity, dark matter, and dark energy. Some researchers revisit Le Sage's ideas, hoping to reconcile them with modern physics or explore analogous concepts.
2. **Critiques and Modifications:**
   - **Modified Theories:** Some modern variants of Le Sage's theory attempt to address the original criticisms by proposing different mechanisms or using concepts from quantum mechanics and particle physics. However, none of these alternatives have gained mainstream acceptance.
   - **Challenges:** The primary challenge remains integrating such a theory with established physical laws, particularly the conservation of energy and thermodynamics. Modern physics has not found any empirical evidence for the type of particle fluxes required by Le Sage's original theory.

3. **Future Research Directions:**
    - **Quantum Gravity and Beyond:** While Le Sage's theory is not part of the mainstream search for quantum gravity (a theory that would reconcile general relativity with quantum mechanics), it represents an early attempt to think outside the Newtonian framework. Modern efforts to understand gravity at quantum scales (like string theory and loop quantum gravity) are much more mathematically sophisticated.
    - **Interdisciplinary Studies:** Some researchers interested in the philosophical and historical aspects of science study Le Sage's theory to understand how scientific ideas evolve and are influenced by broader cultural and intellectual trends.

Conclusion

"Pushing Gravity" or Le Sage's theory is an intriguing historical footnote in the study of gravity. While it laid the groundwork for thinking about gravity in non-Newtonian terms, it ultimately could not compete with the explanatory power of Newtonian gravity and Einstein's relativity. The theory's core idea of a pressure-based mechanism for gravity has not found support in empirical evidence or modern physics, making it more of a curiosity than a viable scientific theory today. However, the exploration of alternative theories continues, driven by the quest to understand gravity at its most fundamental level.

[ii] Planck captures a portrait of the young Universe, revealing the earliest light. University of Cambridge (March **2013**), Retrieved 21 March 2013.

[iii] This was recognized early on by physicists and astronomers working in cosmology in the 1930s. The earliest Layman publication describing the details of this correspondence is Eddington, Arthur (**1933**). The Expanding Universe: Astronomy's 'Great Debate', 1900–1931. Cambridge University Press. (Reprint: ISBN 978-0-521-34976-5). Overview of products and scientific results – Table 9. Astronomy and Astrophysics, 1303, 5062. arXiv:1303.5062. Bibcode:2014A&A...571A...1P. doi:10.1051/0004-6361/201321529.

[iv] "...dark matter: An invisible, essentially collision-less component of matter that makes up about 25 percent of the energy density of the universe... it's a different kind of particle...something not yet observed in the laboratory..."

- British philosopher J.M.E. McTaggart advanced this idea in **1908** in his paper titled "The Unreality of Time: http://en.wikisource.org/wiki/The_Unreality_of_Time," last visited 17.07.2017. Philosophers widely consider his paper to be one of the most influential early examinations of this possibility. Looking through McTaggart's philosophical lens, a reality without time becomes a little more intuitive and, in principle, possible.

A Tale of Two Times

- Several interpretations of McTaggart's argument against the reality of time have been put forth. The author's argument starts with a distinction about ordering events in time. The "A" series and "B" series of time form an integral part of McTaggart's argument, which is explicated below by using a historical event as an example.
- On July 20, **1969**, Apollo 11 became the first manned spacecraft to land on the Moon. For the purpose of this discussion, consider this event to represent an event during the present. Several days in the past (July 16), Apollo 11 lifted off the ground. Additionally, several days in the future, all of the mission astronauts will land back on Earth, safe and sound. Classifying an event as "several days prior" or "several days in the future" fits into the "A" series. With respect to the Moon landing, some events (e.g., Lincoln's assassination) are in the distant past, while others are in the distant future (e.g., the inauguration of President Obama), with numerous other events occurring somewhere in between.
- Under the "A" series, events flow from one classification (*i.e.,* past, present and future) to another. On July 16th, the Moon landing would have the property of being in the future. The instant the Apollo 11 landed on the Moon, that event would be deemed as occurring in the present. After this moment, its classification changes to the past.
- The "B" series, however, does not classify events on this scale ranging from the distant past to the distant future. Instead, the "B" series orders events based on their relationship to other events. Under this ordering, Lincoln's assassination occurs *before* the Moon landing, and Obama's inauguration occurs *after* the Moon landing. This relational ordering seems to capture a different way of looking at time.

Two Times, One Contradiction

- Having made this distinction, McTaggart additionally argues that a fundamental series of time requires a change to take place. Under the "B" series, the way these events are ordered never changes. Obama's inauguration, for instance, will never change properties and occur before the Moon landing and vice versa. These relational properties are simply immutable.
- On the other hand, the "A" series does embody the change that we might expect from the flow of time. All events first have the property of being in the future, before becoming current events unfolding in the present. Afterwards, they drift into the past. Under the "A" series, time does have an objective flow, and true change does take place. In McTaggart's view (which is perhaps held by many others), this change is a necessary aspect of time.
- But herein lies the contradiction. If these events do change in this sense, they will have contradictory properties. McTaggart argues that an event cannot be simultaneously in the past, in the present, and in the future. As these properties are incompatible, the "A" series leads to a contradiction. Consequently, time, which requires change, does not truly exist. Welcome to the timeless reality!

AN EXPERIMENT COMPARING ANGULAR DIAMETER DISTANCES BETWEEN PAIRS OF QUASARS

J. E. Mullat * and F. W. Noble **

Abstract. We conducted an experiment to compare the angular diameters of distances between pairs of quasars using data from publicly available sources. The evaluations were performed using two novel methods, which proved to be theoretically sound in their estimates of the comoving angular diameter when compared to two independent datasets.

Our analysis revealed that it is feasible to apply the Hubble diagram in this context. The Hubble diagram, which plots the relationship between the redshift of objects and their distances, is traditionally used to illustrate the expansion of the universe. When used in a comoving manner, the Hubble diagram tended to underestimate the angular diameter distances between quasars. This discrepancy occurs because the Hubble diagram is typically calibrated for more local, non-cosmological scales, and thus it does not account for the intricate variations at larger cosmological distances.

In contrast, our first method overestimated the angular diameters, suggesting that the method might incorporate assumptions or parameters that overcompensate for the cosmological effects. In layman's language, our technique effectively performs a "zoom-in" (+zoom) effect, magnifying the distances, whereas the Hubble diagram exhibits a "zoom-out" (-zoom) effect at large distances.

The best fit for the data was achieved with the second method, which likely incorporates a more balanced set of cosmological parameters, providing a more accurate representation of the true angular diameter distances between quasars. All of our conclusions are based on rigorous statistical reasoning, ensuring that the observed coincidences are unlikely to be due to chance, error, or other extraneous factors. This underscores the complexity of accurately calculating the distances to cosmological objects.

The methods and tools used to measure such distances must account for a variety of cosmological factors, such as the curvature of space-time and the distribution of visual matter and vacuum, which together synthesize the 'dimension' of the universe. Additionally, while the expansion of this space is ongoing in a static mode, this stands in contrast to the standard cosmological model theoretical postulates. These complexities make the task of estimating distances to cosmological objects far more challenging than many astronomers might initially assume.

Furthermore, our findings emphasize the importance of continuously refining astronomical models and methods. As our understanding of the universe's structure and dynamics evolves, so too must the techniques we use to measure and interpret these vast distances. The interplay between theory and observation is crucial in advancing our knowledge of cosmology and improving the accuracy of distance measurements in the universe.
Keywords: Redshift, Visible Matter, Quasars, Pair, Projection

1. Introduction

In astronomy one of the fundamental issues, which are understood by professional astronomers as well as by amateurs, is the determination of distances to cosmological objects (Czerny et al. 2018), such as galaxies, including individual stars, star clusters, radiation belts, quasars, jets, etc. For this purpose, along with the Hubble constant

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H_0, the relativistic Doppler effect is usually used. If used incorrectly, this leads astronomers to an erroneous estimate of the size of the Universe, but the size of the universe was always considered to be far greater than the distances we could ever see. For the truth of the statement it is necessary to adopt alternative postulates.

Most astronomers believe that Doppler effect is the correct answer, because astronomers as terrestrial observers are measuring distances to galaxies in the neighborhood. Few others rightly emphasize that the Doppler effect is not the correct answer, which has nothing to do with the reality, in particular when applied to cosmological objects located far away, thus having high redshift values. The Hubble law is very accurately fulfilled for the small z values of redshifts. However, for large values, the Hubble's law validity is in doubt.

The more difficult question is due to which courses the redshift occurs. Here we have no clear answer as in the first and in the second case. The issue of redshift is allegedly associated with the expansion of the universe. The expanding Universe model potentially has two flaws: first, the brightness of celestial objects can depend on many factors, not only on their distance. That is, the distances calculated from the apparent brightness of galaxies may be invalid. Secondly, it is quite possible that the redshift is completely unrelated to the speed of the galaxies. This premise is the purpose of all our discussions.

Hubble continued his research and came to a certain model of the expanding universe, which resulted in the Hubble's law. To explain it, we first recall that, according to the Big Bang model, the further the galaxy is from the epicenter of the explosion, the faster it moves. According to the Hubble's law, the rate of removal of galaxies from the terrestrial observer should be equal to the distance to the epicenter of the explosion, multiplied by a number called the Hubble constant. Using this law, astronomers calculate the distance to galaxies, based on the magnitude of the redshift, the origin of which is not completely clear to anyone. In general, astronomers decided to measure the Universe very simply. Find the velocity of galaxy, which depends on the redshift. Multiply the velocity by the redshift and divide the product by the Hubble constant. You will get the distance to any galaxy. In the same way, modern astronomers with the help of the Hubble constant calculate the size of the universe. The reciprocal of the Hubble constant has the meaning of the characteristic time of the expansion of the Universe at the current moment. This is where the feet of the Universe are growing. Hubble never believed in an expanding universe although one can find a great many websites making this statement.

Instead this is what he believed: On these, and other grounds, he (Edwin Hubble) was inclined, thus, to reject the Doppler-interpretation (galaxies moving away from each other and an expanding universe) of the redshifts and to regard the nebulae (galaxies) as stationary—and that an undiscovered reason for the observed redshift was probably responsible, https://en.wikiquote.org/wiki/Edwin_Hubble, visited 4/27/2019. It was only much later that the expansion of space was proposed to explain redshifts.

This made sense to most theorists in that if space could warp, according to Einstein, then it seemingly could expand or contract. A consensus explanation as to why space should expand has not immerged since the expansion of space hypothesis was proposed roughly 50 years ago.

For example, in 1929, the Hubble constant was equal to 500. In 1931, it was equal to 550. In 1936, it was 520 or 526. In 1950, it was 260, i.e. dropped significantly. In 1956, it fell even more: to 176 or 180. In 1958, it further decreased to 75, and in 1968 jumped to 98. In 1972, its value ranged from 50 to 130. Today, the Hubble constant is considered to be between 72.4 and 67.15 depending on the method being used for its calculation. All these changes allowed one astronomer to say with humor that it would be better to call the Hubble constant the Hubble variable, which is now considered likely by many. In other words, it is believed that the Hubble constant changes over time, but the term "constant" is justified by the fact that at any given moment in time the Hubble constant would accordingly be the same at all points in the Universe. [1]

Of course, all these changes over the decades can be explained by the fact that scientists improved their methods and the quality of calculations. But, the question arises: what kind of calculations? We repeat once again that no one can actually verify these calculations, because a *roulette* (even if it was a laser beam that could reach a neighboring galaxy) has not been invented yet. Also, even with regard to distances between galaxies; all this seems incomprehensible to many considering the rationale. If the Universe expands, according to the law of proportionality, evenly, then for what reason then would so many scientists get so many different values of distances based on the same proportions of the speeds of this expansion? It turns out that these proportions of expansion as such also do not exist.

2. General preliminary remarks

Today we have the technology to determine quasar distances, after many decades of study, because finally most mainstream astronomers realize that quasars are exactly the same thing as the centers of active galaxies, from which one of their bi-polar beams are faced in our direction. No astronomers have tried to measure these distances aside from the redshift of their polar beam because it would require special equipment to block out the polar beam to hopefully be able to measure the redshift of the galaxy itself rather than just the polar beam redshift. That being said, they would still be using the Hubble formula to calculate distances, which would be good enough for most quasars where they might be off by a factor of 20% rather than their present calculation errors, which at a redshift of $z = 2$ to 3 would be off by factor as much as three—underestimating distances.

[1] While writing these and some lines below, techn. Ed translated the content from the public domain **https://alexfl.ru/vechnoe/vechnoe_dopler.html**, accessed online 02.05.2021. The reason is that this site integrates well into the story from an alternative perspective.

Quasar pairs are a very interesting study concerning distances; the problem is that they are only called pairs because of their chance alignment from our perspective. They have, for the most part, different redshifts and different brightness. It is rare when pairs have about the same redshifts. These would interest astronomers the most. *"In 1979, astronomers at Arizona noticed that a pair of quasars, separated by only 6", and known collectively as The Twin Quasar (also known as Twin QSO, Double Quasar, SBS 0957+561, TXS 0957+561, Q0957+561 or QSO 0957+561 A/B), looked remarkably similar of about 17th magnitude, and they both have an equal redshift of 1.413.* If the pairs have about the same redshifts and brightness then they are probably close together but not at the Hubble calculated distances. Only few have the same redshift but different brightness. Mainstream astronomers would say that they are at the same distances from us and are likely close together, where we herby in the study would say that they are far apart in their distances based upon their different brightness, where we could estimate their different distances. Pairs with different redshift could also be very interesting in that those of different redshifts having the same brightness, could be very close to each other even though their redshifts indicate otherwise based upon the Hubble formula.

Quasars provide us with some of the worst distance indicators, based on the original problem proposed by Halton Arp about the distances between quasars, with which we agree. Although for quasars, the distances determined from the redshift indicators, as for galaxies, can be accurately calculated for some of them. However, for others, there will be little or no direct correlation between redshift and distances. A completely arbitrary estimate on our part with regard to distances will be such that 80% of the quasars are to some extent correct, and 20% will be completely unrelated to their redshifts, even if the correct distance formula is applied.

3. Statistical Analysis

In Astronomy and Astrophysics: In the context of the Planck mission and similar studies, brightness enhancement could refer to an increase in the observed brightness of cosmic microwave background (CMB) radiation due to various factors, such as gravitational lensing or the presence of large-scale structures like galaxy clusters.

In Optics and Display Technology: It often refers to techniques or technologies used to make a display screen appear brighter, which might involve the use of special films, backlighting methods, or software adjustments.

In Image Processing: The digital imaging, brightness enhancement involves adjusting the brightness levels of an image to make details more visible, often through software manipulation like contrast adjustment, gamma correction, etc.

We turn to the analysis of brightness and distances to cosmological objects due to "blind glance" or a certain "statistical ideology" of data evaluation. Blind glance has allowed us, without having special knowledge of observations, to discover some hidden patterns in the data available on the Internet.

A clear understanding of what is at stake needs to be achieved. In our case, we are dealing with an observer for whom the object of observation is a pair of quasars. We turn to the analysis of data on distances to cosmological objects due to "blind glance" or a certain ideology of data evaluation. Blind glance has allowed us, without having special knowledge of observations, to discover some hidden patterns in the data available on the Internet. A clear understanding of what is at stake needs to be achieved. In our case, we are dealing with an observer for whom the object of observation is a pair of quasars. In the calculations, the Hubble law with a constant $H_0 = 70$ was chosen. Everyone can use any method for calculating distances to cosmological objects as long as we take the length of the angular distance from the point of view of the observer.

3.1. Methods for Calculating Distances to Cosmological Objects

The goal was to compare three methods of calculating distances to cosmological objects:

1. **The postulate of the phase transition of background vector-field energy (gravions, Danilatos, 1920) into matter (Γ-method, Mullat, 2019, Monotone Systems Theory, 1971-1976).**
2. **The method according to the PAN theory (Noble and Cooper, 2014).**
3. **The Hubble's diagram.**

For this purpose, we downloaded several articles from the public domain (Kochanek et al., 1997; Zhdanov and Surdej, 2001; Hennawi et al., 2010; Rogerson and Hall, 2012; Findlay et al., 2018) and compiled dataset (a) with a total of 133 pairs of quasars. Additionally, we downloaded and compiled dataset (b) with a total of 129 pairs of quasars (Decarli et al., 2009; Farina et al., 2014; Sandrinelli et al., 2020).

These two datasets will serve as a basis for comparisons using standard statistical deviations. In these datasets, we found an angular separation θ'' between pairs of quasars and the angular diameter d between the same quasar pairs. Once we succeed in calculating cosmological distances d to the front quasar using the redshift in the pair, we can, given the angle between quasars in the datasets, calculate the angular distance for quasars in the pair using basic trigonometry rules. Specifically, the very small angle measured in seconds ″ allows us to approximate the angular distance by multiplying θ'' by d.

We called diameter r as comoving in the FLRW metric of flat cosmology, that is, the θ'' angular diameter of $\frac{r}{1+z}$ coordinate comoving with the redshift z. *"Comoving distance factors out the expansion of the universe, giving a distance that does not change in time due to the expansion of space (though this may change due to other, local factors, such as the motion of a galaxy within a cluster)."* This assumption about the angular diameter of the visible distances from the position of an observer, placed at the point of observation of a pair of quasars at the opposite end, turns out to be useful. Judging by the borrowed observational datasets (a) and (b), it was acceptable to adjust the apparent angle $\theta'' \cdot (1 \pm \Delta\alpha\%)$ of the comoving diameter by changing the scale of the angular interval of a pair of quasars until the best approximation occurred. This approach made it possible to establish over- or under-estimate indices as percentages relative to the data collected online.

By doing so, we can then compare $\theta'' \cdot d$ with the corresponding entries in our datasets (a) and (b). This will enable us to calculate six 4x4 dimensional tables of pairwise deviation, each table with a different zooming parameter θ''. Each of these six 4x4 tables (a complete version of these tables, along with graphs, will be provided below) represents pairwise deviations relative to the zooming increment/decline $\Delta\alpha\%$ parameter. The angular distance zooming has been applied to datasets a) and b) and is illustrated by six graphs. These graphs highlight our distance calculation techniques, showing that the error in angular distances calculated using our three described methods for cosmological objects reaches its minimum error in each of the six graphs individually.

This approach allowed us to adjust the angular diameter scale interval such that each of the methods, including the Hubble diagram, provided the best fit, each allegedly with great accuracy, for the physical comoving angular diameters represented in datasets (a) and (b). Given that in the past the brightness was apparently relatively higher (or, similarly, all dimensions and distances might have seemed larger due to a change in the measurement scale), multiplying the distance by a factor of inverse brightness allows us to subtract the current scale of distance measurement. This means we allow a return in time to the most distant parts of the Universe, which we can observe now.

We have also implemented brightness enhancement ΔL (as it seems to us a result of rather convincing reasoning regarding the scales of measuring distances both in the past and in present time intervals) into the PAN formula, Noble and Cooper, according thereby decreased the PAN distances. Instead of the distances calculated by all three methods, we introduced, in the result, the comoving angular diameter between quasars. Namely, we divided the distances by $1 + z$ thereby also reducing the diameter as the redshift increased. That being said, it turned out to be possible to adjust the angular diameter scale interval in such a way that each of the methods, including the Hubble diagram, was best, one by one, and each allegedly with great accuracy estimates physical comoving angular diameters represented in datasets a) and b).

Since in the past the brightness was apparently relatively brighter (or just like all dimensions and distances, and to the same extent that we might have seemed larger in the past due to a change in the measurement scale) then multiplying the distance by a factor of inverse brightness, we subtract the current scale of distance measurement. This means that we allow a return in time to the most distant parts of the Universe, which we can observe now. Using a layman's argument, suppose that we can build a spaceship with an accurate odometer. After the spacecraft has moved from here to there, it will measure the distance and brightness calculated, as it were, in the previous time interval, which can be called the "real" distance. But these are not the distances that we would consider valid today based on our current distance criteria.

According to related paper (Noble and Cooper, 2014) concerning type 1a supernova, the distance formula of the 2)-nd method was very closely confirmed by these supernova observations and calculations. But the model requires two formulas for distance determination: One for measuring distance and the other for determining apparent brightness. Astronomers would have to use both formulas. The brightness formula is needed for corroboration of the distance formula based upon the inverse square law of light intensity to distances. Using a single formula to calculate distances can be exactly calculated, but corroboration and understanding of the calculated distances could never be based upon an expanding-universe model. This method, unlike the first one (Mullat, 2019), takes into account both brightness and distances as follows.

Proposed, https://www.pantheory.org/hubble-formula/ method accessed online 03.24.2021, (Noble and Cooper, with minor technical amendments) can estimate distances to cosmological objects with moderate accuracy, that is, the NC formula:

$$\mathrm{nc}(z) = 18110.607641 \cdot \ln\left(\frac{1+\sqrt{1+z}}{2}\right)^{\sqrt{1+z}} \cdot \sqrt{\frac{1}{1+\Delta L}} \approx 4820.9 \cdot z \cdot \sqrt{\frac{1}{1+\Delta L}},$$

where enhancement $\Delta L = \log\left\langle\left(\left((1+z)^{\frac{t(z)}{2}} - 1\right) \cdot \frac{t(z)}{2} + 1\right) \cdot (1+z)^{10^{\frac{2}{5}}}\right\rangle$ and $t(z) = 9.966 \cdot \sqrt{1+z}$. So, the formula estimates distances depending on the redshift z to be approximately equal to $\mathrm{nc}(z)$ Mpc.

- In Astronomy and Astrophysics: In the context of the Planck mission and similar studies, brightness enhancement could refer to an increase in the observed brightness of cosmic micro-wave background (CMB) radiation due to various factors, such as gravitational lensing or the presence of large-scale structures like galaxy clusters.
- Optics and Display Technology: It often refers to techniques or technologies used to make a display screen appear brighter, which might involve the use of special films, backlighting methods, or software adjustments.
- Image Processing: In digital imaging, brightness enhancement involves adjusting the brightness levels of an image to make de- tails more visible, often through software manipulation like contrast adjustment, gamma correction, etc.

The corroboration factor $\sqrt{\frac{1}{1+\Delta L}}$ appears here for simple reasons. Indeed, let the brightness of the object be denoted as L and the enhancement as ΔL. The ehanced brightness of the object can be expressed in two forms: 1) $L+\Delta L$ and 2) $L\cdot(1+\Delta L)$.

There is a flaw in reasonings when following the rule a) in calculations. According to the inverse square law of brightness, the brightness of objects decreases proportional to inverse square of the distance ρ. This relationship is expressed as $\frac{L+\Delta L}{\rho^2}=\frac{L}{r^2}$, where $r \le \rho$. We cannot exclude the brightness L from this enhancement formula. However, in calculations according to in the form of 2), there is no need to know the brightness of the object itself; we need to know only the enhancement. Enhancenent by definition is given in the form of the second formula. This is the key point of our calculations, which are in perfect agreement with data found in open acsess articles. Below we proceed with the calculation in accord to the reasoning just explained.

Indeed, for an object with a brightness of apparent magnitude L, located at a distance ρ, from the observer, the brightness is enhanced by a certain fraction ΔL of the brightness L. This enhanced brightness will be equal $L\cdot(1+\Delta L)$. Now, it remains to determine a closer distance r to the object with its original brightness, such that the brightness observed matches the brightness of the object with enhanced brightness. The equality should then be maintained as $\frac{L}{r^2}=\frac{L\cdot(1+\Delta L)}{\rho^2}$; after all,

$r = \rho \cdot \sqrt{\frac{1}{1 + \Delta L}}$. For quasar pairs, aside from having equal redshifts, their distance differences can be accurately estimated based on their brightness differences. Therefore, quasars with the same redshifts could be very distant from each other; in some cases, the dimmer of the two could be twice as far away. We can estimate distances based on the inverse square law of light for redshifts up to $z \approx 3$.

3.2. Illustration by graphs and tables

Figures 1 and 2 below visualize dataset a) for $\Delta\alpha = -27\%$ and $\Delta\alpha = -16\%$, respectively, while Figures 3 and 4 visualize dataset b). We observe an overestimation when $\Delta\alpha < 0$ and an underestimation when $\Delta\alpha > 0$. When $\Delta\alpha = 0$, the angular diameter scale is set as kpc per second, (kpc)s^{-1}, which corresponds to the usual scale. A negative $\Delta\alpha$ indicates a compressed relative scale, while a positive $\Delta\alpha$ indicates an extended relative scale until the minimum standard deviation is reached for both distance calculation methods applied. Figures 5 and 6 visualize the datasets a) and b) similarly.

It is reasonable to use the $\pm\Delta\alpha$ value as an indicator of the deviation of theoretical distances in either direction for datasets a) and b), as presented in Tables 7 and 8 below. Figures 1 and 2 show four traces (kpc on the y-axis, redshifts on the x-axis):

- Figures 1 and 2 show the best estimates by Mullat (2019) and by Noble and Cooper (2014), comparing angular distances for quasar pairs using dataset a) from Findlay et al. (2018).
- Figures 3 and 4 illustrate relationships for projections of quasar pairs using dataset b) from Decarli (2009).
- Figures 5 and 6 depict similar contrasts used for calculating quasar pairs angular distances based on Hubble diagram formula.

The standard deviation 4x4 tables have been calculated for each of Figures 1-6. The legend [**P, G, O, F**] for rows and columns in these tables stands for:

P: PAN angular distances,

G: Γ-angular distances,

O: Hubble angular distances,

F: Angular distances found in datasets a) and b).

For technical reasons, when finding the smallest standard deviation, the diagonal cells in our pairwise deviation tables below are set to 100, which allows the minimum-finding algorithm to bypass the main diagonal.

Figure 1.

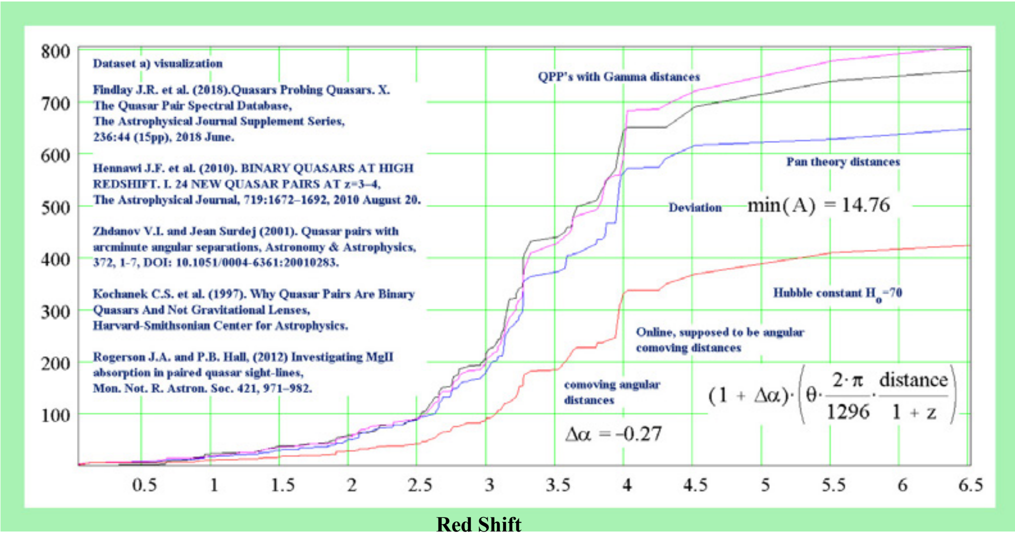
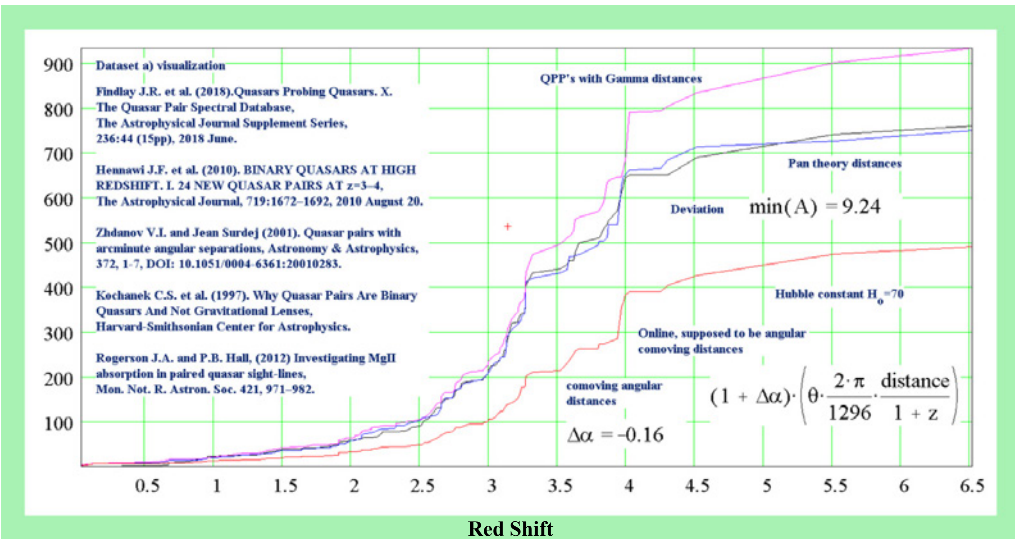


Figure 2.



Standard deviation Tables 1,2

$$A = \begin{array}{c} \\ \\ \\ \\ \end{array}\begin{array}{cccc} P & G & O & F \\ \end{array}$$

$$A = \begin{bmatrix} 100.00 & 29.64 & 72.36 & 28.34 \\ 29.64 & 100.00 & 97.64 & 14.76 \\ 72.36 & 97.64 & 100.00 & 99.49 \\ 28.34 & 14.76 & 99.49 & 100.00 \end{bmatrix} \begin{matrix} P \\ G \\ O \\ F \end{matrix} \qquad A = \begin{bmatrix} 100.00 & 34.29 & 83.73 & 9.24 \\ 34.29 & 100.00 & 112.97 & 33.00 \\ 83.73 & 112.97 & 100.00 & 85.22 \\ 9.24 & 33.00 & 85.22 & 100.00 \end{bmatrix} \begin{matrix} P \\ G \\ O \\ F \end{matrix}$$

(Columns of both matrices: P, G, O, F)

Figure 3.

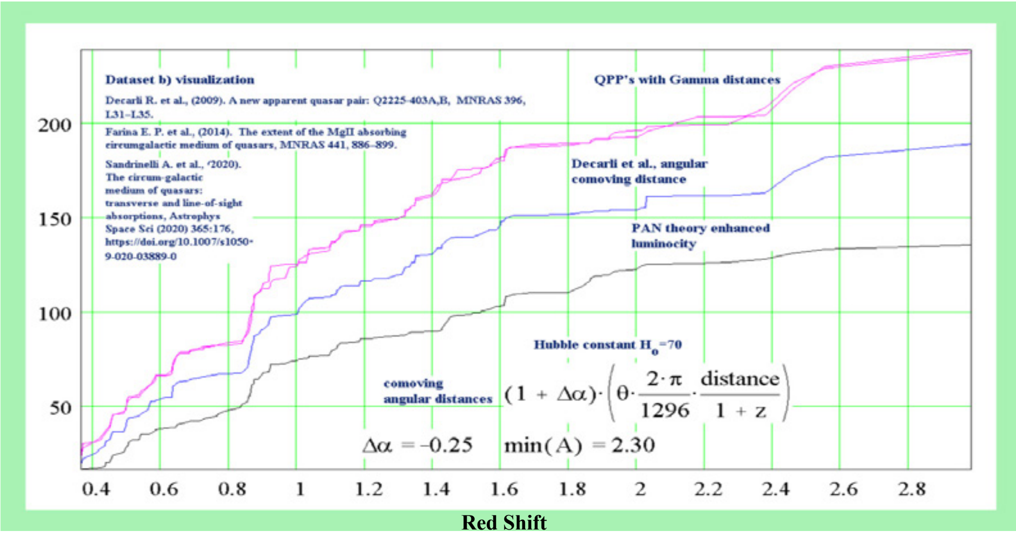
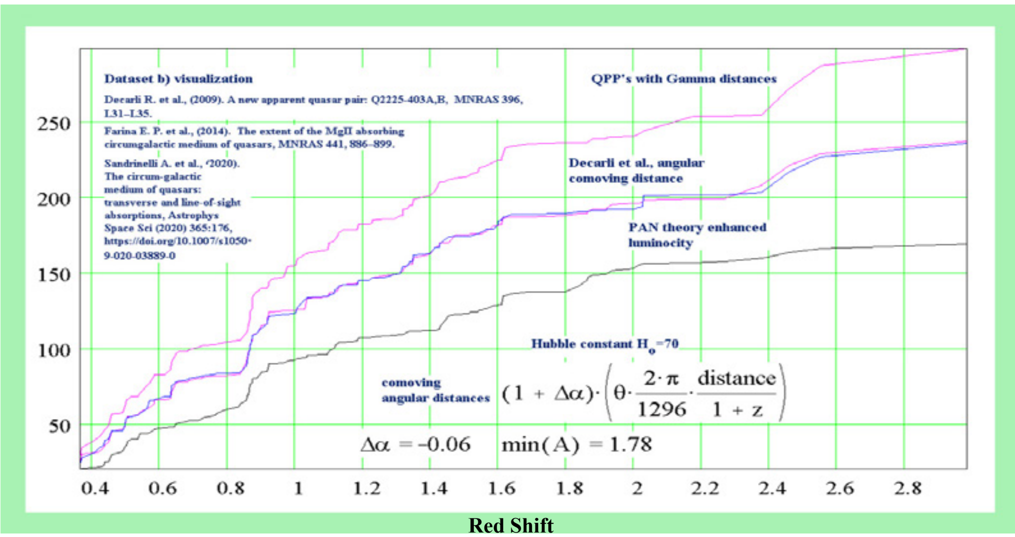


Figure 4



Standard deviation Tables 3,4

$$
\begin{array}{cc}
 & \begin{array}{cccc} P & G & O & F \end{array} \\
A = & \left[\begin{array}{cccc} 100.00 & 10.67 & 10.94 & 10.88 \\ 10.67 & 100.00 & 21.14 & 2.30 \\ 10.94 & 21.14 & 100.00 & 21.33 \\ 10.88 & 2.30 & 21.33 & 100.00 \end{array}\right] \begin{array}{c} P \\ G \\ O \\ F \end{array}
\end{array}
\qquad
\begin{array}{cc}
 & \begin{array}{cccc} P & G & O & F \end{array} \\
A = & \left[\begin{array}{cccc} 100.00 & 13.32 & 13.65 & 1.78 \\ 13.32 & 100.00 & 26.39 & 13.11 \\ 13.65 & 26.39 & 100.00 & 13.78 \\ 1.78 & 13.11 & 13.78 & 100.00 \end{array}\right] \begin{array}{c} P \\ G \\ O \\ F \end{array}
\end{array}
$$

Figure 5

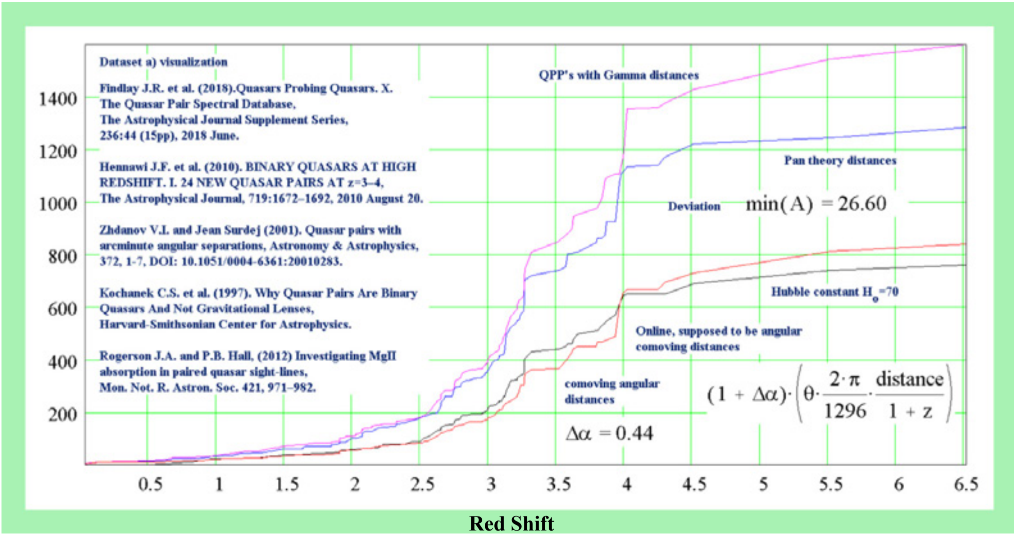
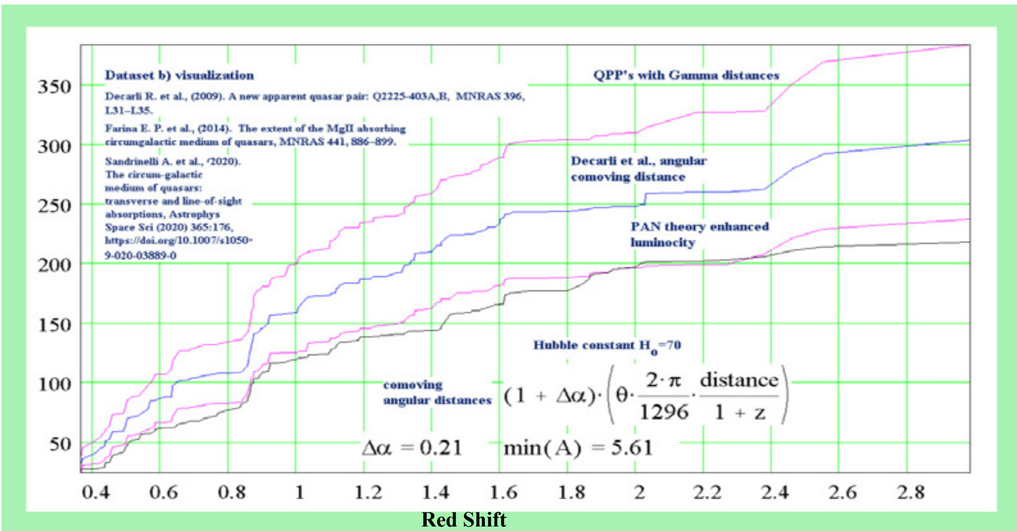


Figure 6



Standard deviation Tables 5,6

A =

	P	G	O	F
P	100.00	58.79	143.53	136.32
G	58.79	100.00	193.67	188.33
O	143.53	193.67	100.00	26.60
F	136.32	188.33	26.60	100.00

A =

	P	G	O	F
P	100.00	17.15	17.58	14.99
G	17.15	100.00	33.97	31.91
O	17.58	33.97	100.00	5.61
F	14.99	31.91	5.61	100.00

Table 7. Findlay et al., (2018). Quasars Probing Quasars. X. The Quasar Pair Spectral Database, The Astroph. Journal Supplement Series, 236:44 (15pp), **rows 1-54**; Hennawi et al., (2010). Binary Quasars at high redshifts, New Quasar Pairs at $z \approx 3 - 4$, The Astroph. Journal, 719:1672–1692, **rows 55-80**; Shdanov and Surdey (2001). Quasar pairs with arcminute angular separations, Article in Astronomy and Astrophysics, **rows 81-91**; Kochanek et al., (1997) and Mortlock et al., (1999). Why Quasar Pairs Are Binary Quasars, And Not Gravitational Lenses, Harvard-Smithsonian Center for Astrophysics, **rows 92-119**; Rogerson J. A. and P. B. Hall (2012). Investigating MgII absorption in paired quasar sight-lines, Mon. Not. R. Astron. Soc. 421, 971–982, **rows 120-133**.

A Note amended for our purposes. From left to right: 1) *column give the names of the foreground quasars*; 2) *the foreground quasar redshifts*; 3) *the on-sky angular separation between the pair in arc seconds"*; 4*) the physical, i.e., comoving transverse distance between the line of sight of the background quasar and the foreground quasar in pkpc*; 5) Estimates of pkpc using Gamma distance; 6) Estimates of pkpc using PAN distance; 7) Estimates of Hubble's diagram (pkpc); Differences between Findlay et al. and those: 8) in Gamma pkpc; 9) in PAN (pkpc); and 10) in Hubble's diagram (pkpc).

	Table 7 QSOfg	Zfg	M"	Proj. pkpc	G pkpc	PAN pkpc	HBL pkpc	G - Proj.	PAN - Proj.	HBL - Proj.
1	J003308.63–083222.19	3.038	27.54	216.00	237	218	105	21	2	-111
2	J012902.78+191824.46	2.680	25.80	210.00	232	205	105	22	-5	-105
3	J015415.22+032455.84	2.660	18.24	149.00	165	145	75	16	-4	-74
4	J022845.72–124643.92	1.733	41.28	358.00	400	323	201	42	-35	-157
5	J023229.05–100123.48	2.063	38.46	329.00	368	305	177	39	-24	-152
6	J031855.31–103040.30	2.226	58.92	498.00	556	468	263	58	-30	-235
7	J032926.40–134732.22	2.073	59.52	509.00	569	471	273	60	-38	-236
8	J033347.40–133928.44	2.230	30.78	260.00	290	244	137	30	-16	-123
9	J034952.34–110620.59	2.449	55.20	459.00	510	439	236	51	-20	-223
10	J090551.96+253003.35	3.325	24.66	188.00	204	194	89	16	6	-99
11	J090828.30+080313.18	2.390	23.10	193.00	215	184	100	22	-9	-93
12	J091800.77+153621.46	2.980	9.90	78.00	86	78	38	8	0	-40
13	J093240.91+400905.65	2.962	25.56	203.00	222	202	99	19	-1	-104
14	J093836.78+100905.34	2.504	22.56	187.00	207	179	95	20	-8	-92
15	J095503.57+614242.66	2.739	5.58	45.00	50	44	23	5	-1	-22
16	J095549.38+153838.11	0.830	6.18	48.00	51	41	32	3	-7	-16
17	J095629.72+243441.34	2.979	25.50	201.00	221	202	98	20	1	-103
18	J100205.70+462411.82	3.138	29.40	229.00	249	232	110	20	3	-119
19	J100253.37+341924.03	2.418	11.40	95.00	106	91	49	11	-4	-46
20	J100903.16–142104.27	2.033	59.70	511.00	572	472	276	61	-39	-235
21	J101853.24–160727.80	2.331	40.32	338.00	377	320	176	39	-18	-162
22	J102947.32+120817.11	2.820	23.94	192.00	212	190	95	20	-2	-97
23	J103109.37+375749.68	2.752	17.52	142.00	156	139	71	14	-3	-71
24	J103716.68+430915.57	2.676	29.34	239.00	264	233	120	25	-6	-119
25	J104314.33+143434.81	2.980	9.36	74.00	81	74	36	7	0	-38
26	J104339.12+010531.29	3.240	26.70	205.00	223	210	98	18	5	-107
27	J105202.95–103803.70	2.104	12.12	103.00	116	96	55	13	-7	-48
28	J105338.15–081623.66	2.192	30.72	260.00	291	244	138	31	-16	-122
29	J105354.90–100941.44	3.232	11.52	89.00	96	91	42	7	2	-47

30	J110402.08+132154.46	2.869	21.96	176.00	*193*	*174*	*87*	*17*	*-2*	*-89*
31	J110124.79–105645.12	2.579	18.48	152.00	*168*	*147*	*77*	*16*	*-5*	*-75*
32	J111820.36+044120.22	3.120	5.28	41.00	*45*	*42*	*20*	*4*	*1*	*-21*
33	J112032.04–095203.21	2.180	26.52	225.00	*251*	*210*	*119*	*26*	*-15*	*-106*
34	J112239.32+450618.54	3.590	29.16	216.00	*232*	*228*	*101*	*16*	*12*	*-115*
35	J112355.97–125040.73	2.965	54.48	431.00	*473*	*431*	*211*	*42*	*0*	*-220*
36	J112516.06+284057.59	2.845	25.26	203.00	*223*	*200*	*100*	*20*	*-3*	*-103*
37	J112839.64–144842.36	1.920	53.28	459.00	*513*	*420*	*251*	*54*	*-39*	*-208*
38	J112913.52+662039.13	2.807	24.84	200.00	*220*	*197*	*99*	*20*	*-3*	*-101*
39	J113820.28+203336.93	2.687	4.26	34.00	*38*	*34*	*17*	*4*	*0*	*-17*
40	J114443.59+102143.48	1.503	26.16	227.00	*253*	*201*	*132*	*26*	*-26*	*-95*
41	J115037.52+422421.01	2.883	24.66	197.00	*216*	*195*	*97*	*19*	*-2*	*-100*
42	J115222.15+271543.29	3.102	4.80	38.00	*41*	*38*	*18*	*3*	*0*	*-20*
43	J120032.34+491951.99	2.629	29.88	244.00	*271*	*237*	*123*	*27*	*-7*	*-121*
44	J121642.25+292537.97	2.532	10.68	88.00	*98*	*85*	*45*	*10*	*-3*	*-43*
45	J122900.87+422243.23	3.842	21.48	156.00	*165*	*167*	*71*	*9*	*11*	*-85*
46	J123055.78+184746.79	3.169	19.26	149.00	*163*	*152*	*72*	*14*	*3*	*-77*
47	J132728.77+271311.96	3.085	19.20	150.00	*164*	*152*	*73*	*14*	*2*	*-77*
48	J134221.26+215041.97	3.062	21.72	170.00	*186*	*172*	*83*	*16*	*2*	*-87*
49	J135456.96+494143.74	3.126	10.50	82.00	*89*	*83*	*39*	*7*	*1*	*-43*
50	J141457.24+242039.67	3.576	26.64	198.00	*213*	*208*	*92*	*15*	*10*	*-106*
51	J143622.50+424127.13	3.000	7.44	59.00	*64*	*59*	*29*	*5*	*0*	*-30*
52	J144225.30+625600.96	3.271	29.40	226.00	*245*	*231*	*108*	*19*	*5*	*-118*
53	J162413.70+183330.72	2.763	23.58	190.00	*210*	*187*	*95*	*20*	*-3*	*-95*
54	J214858.11–074033.28	2.660	1.86	15.00	*17*	*15*	*8*	*2*	*0*	*-7*
55	J0004-0844A	2.998	4.40	35.00	*38*	*35*	*17*	*3*	*0*	*-18*
56	J0829+2927A	3.054	40.30	322.00	*346*	*319*	*153*	*24*	*-3*	*-169*
57	J0956+2643A	3.087	16.50	131.00	*141*	*130*	*62*	*10*	*-1*	*-69*
58	J0959+1032A	4.024	44.10	320.00	*330*	*341*	*141*	*10*	*21*	*-179*
59	J1016+4040A	2.996	68.20	548.00	*590*	*540*	*263*	*42*	*-8*	*-285*
60	J1021+1112A	3.805	7.60	56.00	*59*	*59*	*25*	*3*	*3*	*-31*
61	J1053+5001A	3.078	2.10	17.00	*18*	*17*	*8*	*1*	*0*	*-9*
62	J1054+0215A	3.984	88.30	644.00	*664*	*684*	*285*	*20*	*40*	*-359*
63	J1116+4118A	2.982	13.80	111.00	*120*	*109*	*53*	*9*	*-2*	*-58*
64	J1118+0202A	3.939	83.80	613.00	*634*	*650*	*273*	*21*	*37*	*-340*
65	J1150+4659A	3.005	34.90	280.00	*301*	*276*	*134*	*21*	*-4*	*-146*
66	J1159+3426A	3.135	51.20	405.00	*435*	*404*	*192*	*30*	*-1*	*-213*
67	J1248+1957A	3.872	64.80	477.00	*495*	*503*	*213*	*18*	*26*	*-264*
68	J1251+2715A	3.660	13.90	105.00	*110*	*109*	*47*	*5*	*4*	*-58*
69	J1307+0422A	3.021	8.20	66.00	*71*	*65*	*31*	*5*	*-1*	*-35*
70	J1312+4616A	3.971	85.70	625.00	*646*	*664*	*277*	*21*	*39*	*-348*
71	J1353+4852A	3.863	37.10	273.00	*284*	*288*	*122*	*11*	*15*	*-151*
72	J1404+4005A	3.999	47.30	344.00	*355*	*366*	*152*	*11*	*22*	*-192*
73	J1414+3955A	3.218	30.70	242.00	*258*	*242*	*113*	*16*	*0*	*-129*
74	J1420+2831A	4.305	10.90	77.00	*78*	*84*	*33*	*1*	*7*	*-44*
75	J1439-0033A	4.255	33.40	237.00	*242*	*257*	*103*	*5*	*20*	*-134*
76	J1541+2702A	3.623	6.40	48.00	*51*	*50*	*22*	*3*	*2*	*-26*
77	J1546+5134A	2.961	42.20	340.00	*367*	*334*	*164*	*27*	*-6*	*-176*
78	J1622+0702A	3.264	5.80	45.00	*48*	*46*	*21*	*3*	*1*	*-24*
79	J1626+0904A	3.632	52.70	398.00	*417*	*412*	*181*	*19*	*14*	*-217*
80	J1630+1152A	3.277	23.80	186.00	*198*	*187*	*87*	*12*	*1*	*-99*
81	Q0053-3342A	2.000	83.70	650.00	*803*	*662*	*389*	*153*	*12*	*-261*
82	Q0107-0235	0.958	77.50	570.00	*680*	*540*	*405*	*110*	*-30*	*-165*
83	CTS-H26.12	2.330	58.90	450.00	*551*	*468*	*257*	*101*	*18*	*-193*

84	Q1310+4254A	2.561	91.40	690.00	*834*	*726*	*382*	*144*	*36*	*-308*
85	1WGA	1.890	82.20	650.00	*793*	*648*	*390*	*143*	*-2*	*-260*
86	1333.2+2604	1.182	68.30	530.00	*636*	*503*	*356*	*106*	*-27*	*-174*
87	Q2121-4642	1.347	82.80	650.00	*790*	*626*	*426*	*140*	*-24*	*-224*
88	Q2139-4433	3.220	62.60	440.00	*525*	*493*	*231*	*85*	*53*	*-209*
89	QSM1:35	1.123	70.10	540.00	*645*	*510*	*367*	*105*	*-30*	*-173*
90	1336.5+2804	1.310	94.70	740.00	*900*	*713*	*489*	*160*	*-27*	*-251*
91	HE_1104-1805	2.320	3.10	24.00	*29*	*25*	*14*	*5*	*1*	*-10*
92	HS_1216+5032	1.450	9.10	78.00	*88*	*70*	*46*	*10*	*-8*	*-32*
93	J-164313156	0.590	2.30	16.00	*16*	*13*	*11*	*0*	*-3*	*-5*
94	LBQS_1429{008	2.080	5.10	42.00	*49*	*40*	*23*	*7*	*-2*	*-19*
95	LBQS_2153-2056	1.850	7.80	64.00	*75*	*61*	*37*	*11*	*-3*	*-27*
96	MG_0023+171	0.950	4.80	40.00	*42*	*33*	*25*	*2*	*-7*	*-15*
97	MG_2016+112	3.270	3.60	26.00	*30*	*28*	*13*	*4*	*2*	*-13*
98	MGC_2214+3550	0.880	3.00	26.00	*26*	*20*	*16*	*0*	*-6*	*-10*
99	PKS_1145-071	1.350	4.20	36.00	*40*	*32*	*22*	*4*	*-4*	*-14*
100	Q_0151+048y	1.910	3.30	28.00	*32*	*26*	*16*	*4*	*-2*	*-12*
101	Q_0957+561	1.410	6.10	52.00	*59*	*46*	*31*	*7*	*-6*	*-21*
102	Q_1120+0195yy	1.460	6.50	56.00	*63*	*50*	*33*	*7*	*-6*	*-23*
103	Q_1343+2640	2.030	9.50	78.00	*91*	*75*	*44*	*13*	*-3*	*-34*
104	Q_1635+267	1.960	3.80	32.00	*37*	*30*	*18*	*5*	*-2*	*-14*
105	Q_2138-431	1.640	4.50	38.00	*44*	*35*	*22*	*6*	*-3*	*-16*
106	Q_2345+007	2.150	7.30	58.00	*69*	*58*	*33*	*11*	*0*	*-25*
107	Q-0101.823012	0.890	17.00	132.00	*145*	*116*	*88*	*13*	*-16*	*-44*
108	Q-015110448a	1.910	3.30	28.00	*32*	*26*	*16*	*4*	*-2*	*-12*
109	Q-112010195b	1.470	6.50	55.00	*63*	*50*	*33*	*8*	*-5*	*-22*
110	Q-120811011	3.800	0.50	3.00	*4*	*4*	*2*	*1*	*1*	*-1*
111	Q-134312640	2.030	9.50	79.00	*91*	*75*	*44*	*12*	*-4*	*-35*
112	Q-142920053	2.080	5.10	42.00	*49*	*40*	*23*	*7*	*-2*	*-19*
113	Q-16341267	1.960	3.80	32.00	*37*	*30*	*18*	*5*	*-2*	*-14*
114	Q-21382431	1.640	4.50	38.00	*44*	*35*	*22*	*6*	*-3*	*-16*
115	Q-215322056	1.850	7.80	66.00	*75*	*61*	*37*	*9*	*-5*	*-29*
116	Q-23451007	2.150	7.30	61.00	*69*	*58*	*33*	*8*	*-3*	*-28*
117	Q23540+1839	1.666	96.20	760.00	*933*	*750*	*474*	*173*	*-10*	*-286*
118	QJ_0240-343	1.410	6.10	52.00	*59*	*46*	*31*	*7*	*-6*	*-21*
119	RXJ_0911.4+0551	2.800	3.10	24.00	*27*	*25*	*12*	*3*	*1*	*-12*
120	Q1343+266	0.520	9.50	58.95	*62*	*51*	*43*	*3*	*-8*	*-16*
121	Q1343+267	1.520	10.50	59.95	*101*	*81*	*53*	*42*	*21*	*-7*
122	Q1343+268	2.520	11.50	60.95	*105*	*91*	*48*	*44*	*30*	*-12*
123	Q1343+269	3.520	12.50	61.95	*101*	*98*	*44*	*39*	*36*	*-18*
124	Q1343+270	4.520	13.50	62.95	*94*	*103*	*40*	*31*	*40*	*-23*
125	Q1343+271	5.520	14.50	63.95	*88*	*108*	*37*	*24*	*44*	*-27*
126	Q1343+272	6.520	15.50	64.95	*82*	*112*	*35*	*17*	*47*	*-30*
127	HS_1216+5032	0.040	9.10	7.93	*6*	*6*	*6*	*-2*	*-2*	*-2*
128	HS_1216+5032	0.140	9.10	21.83	*20*	*20*	*18*	*-2*	*-2*	*-4*
129	SDSS_J1029+2632	0.670	1.77	10.53	*13*	*11*	*9*	*3*	*0*	*-2*
130	SDSS_J1029+2632	1.760	1.77	1.34	*17*	*14*	*9*	*16*	*13*	*7*
131	SDSS_J1029+2632	1.910	1.77	0.81	*17*	*14*	*8*	*16*	*13*	*8*
132	J0904+1512	1.220	1.13	0.52	*11*	*8*	*6*	*10*	*8*	*5*
133	J1054+2733	0.680	1.27	1.87	*10*	*8*	*6*	*8*	*6*	*4*
		Rows 1-54 standard deviation, Fanomo et al.						15.0	12.4	58.5
		Rows 55-99 standard deviation, Hennawi et al.						10.3	14.4	108.8
		Rows 1-133, total standard deviation						34.9	16.4	88.3

Table 8. Sandrinelli et al. (2020). The circum-galactic medium of quasars: transverse and line-of-sight absorptions, Astrophysics Space Sci 365:176, **rows 1-14**; Farina et al. (2014). The extent of the MgII absorbing circumgalactic medium of quasars, MNRAS 441, 886–899, **rows 15-32**; Decarli R. at al. (2009). A new apparent quasar pair: Q2225-403A,B, MNRAS 396, L31–L35, **rows 33-52**; Farina E. P. (2012). Physical and Projected Pairs of Quasars, A Thesis submitted for the degree of Doctor of Philosophy, supervisor: A. Treves, co–supervisor: R. Falomo, **rows 53-129**.

	Table 8 ID	Zfg	Arc sec	Proj. (kpc)	G pkpc	PAN pkpc	HBL pkpc	G - Proj.	PAN - Proj.	HBL - Proj.
1	Sandr.1	0.66	3.7	25	31	25	20	6	0	-5
2	Sandr.2	0.9	3.6	30	35	28	21	5	-2	-9
3	Sandr.3	0.88	28.6	221	272	217	166	51	-4	-55
4	Sandr.4	0.86	25.4	196	240	191	147	44	-5	-49
5	Sandr.5	1.13	28.9	237	298	236	169	61	-1	-68
6	Sandr.6	1.1	13.7	112	140	111	80	28	-1	-32
7	Sandr.7	0.84	27.3	208	255	203	157	47	-5	-51
8	Sandr.8	1.03	16.9	136	170	135	99	34	-1	-37
9	Sandr.9	0.98	19.0	151	188	149	111	37	-2	-40
10	Sandr.10	0.64	28.7	198	236	192	157	38	-6	-41
11	Sandr.11	1.12	27.9	229	287	227	163	58	-2	-66
12	Sandr.12	0.86	19.3	148	182	145	112	34	-3	-36
13	Sandr.13	0.77	6.3	47	57	45	36	10	-2	-11
14	Sandr.14	0.71	11.3	82	98	79	63	16	-3	-19
15	Farin.1	0.79	12.1	91	110	88	69	19	-3	-22
16	Farin.2	1.62	9.4	80	102	82	52	22	2	-28
17	Farin.3	1.12	21.4	175	220	174	125	45	-1	-50
18	Farin.4	1.32	22.2	186	236	187	128	50	1	-58
19	Farin.5	1.00	22.0	176	219	174	129	43	-2	-47
20	Farin.6	0.92	15.9	125	154	123	93	29	-2	-32
21	Farin.7	0.88	18.8	145	179	142	109	34	-3	-36
22	Farin.8	0.69	19.5	138	166	134	108	28	-4	-30
23	Farin.9	1.04	8.2	66	83	65	48	17	-1	-18
24	Farin.10	0.73	16.0	116	140	113	90	24	-3	-26
25	Farin.11	1.60	22.0	176	239	191	123	63	15	-53
26	Farin.12	1.19	17.8	147	186	147	104	39	0	-43
27	Farin.13	0.63	28.6	196	233	190	155	37	-6	-41
28	Farin.14	1.10	19.0	156	195	154	111	39	-2	-45
29	Farin.15	0.92	21.7	170	210	167	126	40	-3	-44
30	Farin.16	1.23	13.1	109	138	109	76	29	0	-33
31	Farin.17	0.87	23.7	183	224	179	137	41	-4	-46
32	Farin.18	1.43	23.6	199	254	202	135	55	3	-64
33	Decar.1	1.55	6.3	53	68	54	35	15	1	-18
34	Decar.2	2.03	7.7	64	83	68	40	19	4	-24
35	Decar.3	1.30	8.1	67	86	68	47	19	1	-20
36	Decar.4	1.44	9.8	82	106	84	56	24	2	-26
37	Decar.5	2.18	9.5	78	101	84	48	23	6	-30
38	Decar.6	1.34	6.6	55	70	56	38	15	1	-17
39	Decar.7	1.63	4.5	38	49	39	25	11	1	-13
40	Decar.8	1.14	3.8	31	39	31	22	8	0	-9
41	Decar.9	2.38	7.4	60	77	66	36	17	6	-24
42	Decar.10	2.00	3.9	32	42	35	20	10	3	-12

43	Decar.11	0.44	4.4	24	*28*	*24*	*21*	*4*	*0*	*-3*
44	Decar.12	1.31	9.9	83	*105*	*83*	*57*	*22*	*0*	*-26*
45	Decar.13	1.26	4.3	35	*45*	*36*	*25*	*10*	*1*	*-10*
46	Decar.14	1.33	9.3	78	*99*	*79*	*54*	*21*	*1*	*-24*
47	Decar.15	1.59	5.7	48	*62*	*49*	*32*	*14*	*1*	*-16*
48	Decar.16	1.52	8.9	75	*96*	*77*	*50*	*21*	*2*	*-25*
49	Decar.17	0.65	8.0	55	*66*	*54*	*44*	*11*	*-1*	*-11*
50	Decar.18	0.89	7.9	61	*75*	*60*	*46*	*14*	*-1*	*-15*
51	Decar.19	1.86	7.5	63	*81*	*66*	*40*	*18*	*3*	*-23*
52	Decar.20	0.93	10.5	83	*102*	*81*	*61*	*19*	*-2*	*-22*
53	QQS01	1.62	16.9	143	*183*	*147*	*94*	*40*	*4*	*-49*
54	QQS02	1.92	21.0	176	*226*	*185*	*111*	*50*	*9*	*-65*
55	QQS03	1.64	16.0	135	*174*	*139*	*89*	*39*	*4*	*-46*
56	QQS04	0.51	9.6	58	*68*	*57*	*48*	*10*	*-1*	*-10*
57	QQS05	0.56	30.5	197	*232*	*191*	*160*	*35*	*-6*	*-37*
58	QQS06	2.03	8.5	71	*91*	*75*	*44*	*20*	*4*	*-27*
59	QQS07	1.61	9.4	79	*102*	*82*	*52*	*23*	*3*	*-27*
60	QQS08	1.13	21.4	175	*221*	*174*	*125*	*46*	*-1*	*-50*
61	QQS09	1.32	22.2	186	*236*	*187*	*128*	*50*	*1*	*-58*
62	QQS10	0.37	21.8	110	*124*	*107*	*94*	*14*	*-3*	*-16*
63	QQS11	1.01	22.0	176	*220*	*174*	*129*	*44*	*-2*	*-47*
64	QQS12	1.35	15.9	133	*170*	*135*	*92*	*37*	*2*	*-41*
65	QQS13	0.92	16.0	125	*155*	*123*	*93*	*30*	*-2*	*-32*
66	QQS14	0.41	32.7	177	*201*	*172*	*149*	*24*	*-5*	*-28*
67	QQS15	1.69	17.7	149	*192*	*155*	*97*	*43*	*6*	*-52*
68	QQS16	0.49	16.5	99	*115*	*97*	*82*	*16*	*-2*	*-17*
69	QQS17	0.86	25.1	192	*237*	*189*	*145*	*45*	*-3*	*-47*
70	QQS18	0.88	18.8	145	*179*	*142*	*109*	*34*	*-3*	*-36*
71	QQS19	0.69	19.4	137	*165*	*134*	*108*	*28*	*-3*	*-29*
72	QQS20	1.04	8.2	66	*83*	*65*	*48*	*17*	*-1*	*-18*
73	QQS21	0.73	16.0	115	*140*	*113*	*90*	*25*	*-2*	*-25*
74	QQS22	2.46	4.5	36	*46*	*40*	*21*	*10*	*4*	*-15*
75	QQS23	1.60	22.3	188	*242*	*194*	*124*	*54*	*6*	*-64*
76	QQS24	1.84	20.0	168	*216*	*176*	*107*	*48*	*8*	*-61*
77	QQS25	0.89	19.6	152	*188*	*149*	*114*	*36*	*-3*	*-38*
78	QQS26	0.42	29.3	162	*185*	*157*	*136*	*23*	*-5*	*-26*
79	QQS27	1.61	22.1	187	*240*	*192*	*123*	*53*	*5*	*-64*
80	QQS28	0.44	14.6	82	*94*	*80*	*69*	*12*	*-2*	*-13*
81	QQS29	1.18	17.8	147	*186*	*147*	*104*	*39*	*0*	*-43*
82	QQS30	0.50	9.3	56	*66*	*55*	*47*	*10*	*-1*	*-9*
83	QQS31	0.77	26.2	193	*235*	*189*	*149*	*42*	*-4*	*-44*
84	QQS32	0.54	15.0	94	*111*	*92*	*77*	*17*	*-2*	*-17*
85	QQS33	0.84	18.2	138	*170*	*136*	*105*	*32*	*-2*	*-33*
86	QQS34	1.35	18.6	156	*199*	*157*	*107*	*43*	*1*	*-49*
87	QQS35	0.54	21.8	138	*162*	*134*	*113*	*24*	*-4*	*-25*
88	QQS36	0.9	23.3	181	*223*	*178*	*135*	*42*	*-3*	*-46*
89	QQS37	0.57	18.7	122	*144*	*118*	*98*	*22*	*-4*	*-24*
90	QQS38	1.87	15.0	126	*162*	*132*	*80*	*36*	*6*	*-46*
91	QQS39	1.40	19.0	160	*204*	*162*	*109*	*44*	*2*	*-51*
92	QQS40	0.59	28.8	189	*224*	*184*	*153*	*35*	*-5*	*-36*
93	QQS41	1.51	5.3	45	*57*	*46*	*30*	*12*	*1*	*-15*
94	QQS42	1.54	14.7	124	*159*	*127*	*83*	*35*	*3*	*-41*
95	QQS43	1.10	17.2	140	*176*	*139*	*101*	*36*	*-1*	*-39*
96	QQS44	0.97	24.2	192	*239*	*189*	*141*	*47*	*-3*	*-51*

97	QQS45	1.10	13.6	111	*139*	*110*	*80*	*28*	*-1*	*-31*
98	QQS46	2.99	13.7	105	*133*	*121*	*59*	*28*	*16*	*-46*
99	QQS47	0.45	32.7	187	*215*	*182*	*156*	*28*	*-5*	*-31*
100	QQS48	1.94	21.2	177	*228*	*187*	*112*	*51*	*10*	*-65*
101	QQS49	1.46	9.1	77	*98*	*78*	*52*	*21*	*1*	*-25*
102	QQS50	1.22	16.4	136	*172*	*136*	*96*	*36*	*0*	*-40*
103	QQS51	0.50	17.0	103	*120*	*100*	*85*	*17*	*-3*	*-18*
104	QQS52	0.37	23.5	120	*135*	*116*	*102*	*15*	*-4*	*-18*
105	QQS53	2.02	22.7	189	*244*	*201*	*118*	*55*	*12*	*-71*
106	QQS55	1.92	16.0	134	*173*	*141*	*85*	*39*	*7*	*-49*
107	QQS56	0.58	18.9	124	*147*	*121*	*100*	*23*	*-3*	*-24*
108	QQS57	1.12	20.8	170	*214*	*169*	*122*	*44*	*-1*	*-48*
109	QQS58	1.80	15.8	133	*171*	*139*	*85*	*38*	*6*	*-48*
110	QQS59	2.27	18.3	150	*193*	*163*	*91*	*43*	*13*	*-59*
111	QQS60	1.57	22.2	187	*240*	*192*	*124*	*53*	*5*	*-63*
112	QQS61	0.37	24.8	126	*142*	*122*	*108*	*16*	*-4*	*-18*
113	QQS62	1.56	11.7	98	*127*	*101*	*66*	*29*	*3*	*-32*
114	QQS63	0.62	20.3	137	*163*	*133*	*109*	*26*	*-4*	*-28*
115	QQS64	1.55	9.6	81	*104*	*83*	*54*	*23*	*2*	*-27*
116	QQS65	0.52	29.3	181	*212*	*176*	*149*	*31*	*-5*	*-32*
117	QQS66	1.48	16.9	142	*182*	*145*	*96*	*40*	*3*	*-46*
118	QQS67	0.64	28.6	195	*234*	*190*	*156*	*39*	*-5*	*-39*
119	QQS68	1.10	19.0	155	*195*	*154*	*111*	*40*	*-1*	*-44*
120	QQS69	0.50	20.5	125	*146*	*122*	*103*	*21*	*-3*	*-22*
121	QQS70	0.92	21.7	170	*210*	*167*	*126*	*40*	*-3*	*-44*
122	QQS71	1.88	9.5	80	*103*	*84*	*51*	*23*	*4*	*-29*
123	QQS72	2.55	20.8	167	*213*	*185*	*97*	*46*	*18*	*-70*
124	QQS73	1.23	13.1	108	*138*	*109*	*76*	*30*	*1*	*-32*
125	QQS74	0.87	23.7	182	*225*	*179*	*137*	*43*	*-3*	*-45*
126	QQS75	0.46	31.4	182	*210*	*177*	*152*	*28*	*-5*	*-30*
127	QQS76	0.58	8.3	54	*64*	*53*	*44*	*10*	*-1*	*-10*
128	QQS77	1.41	22.7	191	*244*	*194*	*130*	*53*	*3*	*-61*
129	QQS78	1.43	23.6	199	*254*	*202*	*135*	*55*	*3*	*-64*
					Standard deviation			14.1	4.474	16.55

4. Discussion

Mainstream astronomy considers redshifts to be a reliable indicator of distances for both galaxies and quasars. From our perspective, quasar pairs appear to be close together. However, a small minority, including Halton Arp and others, believe that quasar redshifts are poor indicators of distance. Consequently, any calculated distances between quasars, apart from galaxies, are purely speculative, as they can actually be hundreds of millions of light-years apart. Quasar pairs with the same redshifts might seem relatively close to each other, but if their brightness differs, their distances from us could vary significantly.

Unlike galaxies, if quasar-pair redshifts relate to their relative distances from us (which we believe they don't), then measuring their comoving distances apart might have some value—otherwise, it would be a waste of time. However, in estimating the real distances to pairs of quasars based on the comoving distances, the error range in our experiment was significantly reduced despite their significant redshifts. If we take this improvement in the calculations as a fact, then most of the quasars are much closer than their redshifts would indicate according to ΛCDM cosmology. Why are their redshifts so big? If this statement and question are correct, then our alternative theories must be a reasonable answer.

Astronomers who believe quasar redshifts are not proper indicators of their distances have attributed quasar redshifts to intrinsic mechanisms such as gravitational redshifts, long known to be valid in some cases but only to a small extent. In the last decade or so, many have realized what they believe to be a more likely intrinsic mechanism. This proposed mechanism would be unpopular for most astronomers and theorists because it suggests that the most powerful galactic jets *'move faster than the speed of light'* relative to the galactic core that ejects them. It has been about 30 years since astronomers first claimed that some large galactic jets move at superluminal speeds. Many astronomy papers from those times, and some from the present, have still claimed that by observation measurement, some quasar jets can move up to five times the speed of light. Over time, mainstream astronomy labeled all these observations as optical illusions, which they continue to do to this date, and provided reasons for their conclusions.

Indeed there is a difficulty here. For large values $z > 1$ of redshifts, the galaxy's receding speed will supposedly exceed the speed of light. The light is shifted to a longer wavelength (redshifted), we know this if e.g., a gas cloud is moving away from us, the speed can be calculated using the Doppler redshift formula for $z = \frac{\Delta\lambda}{\lambda}$:

$$\begin{aligned} v &= c \cdot \frac{\Delta\lambda}{\lambda} = \left(3.0 \cdot 10^{8}\ \mathrm{m/s}\right) \cdot \left(\text{e.g.},\ 0.3\ \mathrm{nm} / 656.3\ \mathrm{nm}\right) = \\ &= \left(3.0 \cdot 10^{8}\ \mathrm{m/s}\right) \cdot \left(0.3 \cdot 10^{-9}\ \mathrm{m}\ 656.3 \cdot 10^{-9}\ \mathrm{m}\right) = 140{,}000\ \mathrm{m/s} = 140\ \mathrm{km/s} \end{aligned}.$$

In "Cosmological Physics", 2012, p.72, John A. Peacock explains that it is "misleading" to apply the "special relativistic Doppler formula" directly when dealing with large redshifts in cosmology. This is because large redshifts are primarily due to the "expansion of space", not the motion of objects through space: *"...it is common but misleading to convert a large redshift to a recession velocity using the special relativistic formula* $1 + z = \sqrt{\left(1 + \frac{v}{c}\right)^{+1} \cdot \left(1 - \frac{v}{c}\right)^{-1}}$. *Any such temptation should be avoided. …Nevertheless it is all too common to read the latest high-redshift quasar as "receding at 95% of the speed of light."*

Despite this, astronomers believe that the Hubble diagram can be used in its relativistic form. In this case, the situation can be improved by excluding the velocity of objects from consideration and applying an elegant formula for distances. This formula, $d = \tanh(\ln(1 + z)) \cdot \frac{c}{H_0}$, implicitly contains Hubble's law, which was used in our calculations [2], and can be successfully applied to moderate redshifts. However, Hubble law significantly underestimates distances compared to data from available online sources for $z > 1$.

Some authors (J. G. von Brzeski and V. von Brzeski, 2003) argue that this formula is a representation of the (hyperbolic) three-dimensional space of the Lobachevskian vacuum: a topologically pair-wise connected, non-compact cosmic ball (universe), of constant negative curvature $k = -1$. Paradoxical conclusion. However, in Brzeski's (2003) words the volume of space, and (taking into account Lerner's et al., 2014:

> *"By contrast, in a static (non expanding) Universe, where the redshift is due to some physical process other than expansion (e.g., light-aging), the SB is expected to dim only by a factor $(1+z)$, or be strictly constant when AB magnitudes are used"),*

the Universe will be grater and will contain more mass than we think. The universe has always existed. The space is as it is and is not expanding and will exist forever.

Determining what is right and what is wrong in this context is challenging. However, by incorporating metrics of curved space into our methods for calculating distances to cosmological objects—specifically using the angular diameter $\theta \cdot \frac{\text{distance}}{1+z}$ of objects in kiloparsecs as a comoving coordinate—we have significantly improved the accuracy of our angular diameter estimates. These improvements are consistent with data from referenced articles.

With these enhanced distance estimations, we can now accurately assess the performance of various methods. Specifically, we can determine whether distances are overestimated or underestimated compared to existing data from articles in databases. This experiment aims to address this issue. Our findings suggest that Hubble's law should not be applied at high redshifts; instead, alternative methods should be used.

In our search for alternative methods within the public domain, we came across intriguing findings that extend the list of paradoxes noted by Forrest and Cooper. Notably, one amateur astronomer, observed varying expansion rates of the universe based on redshift measurements taken in different directions. His observations led to an even more remarkable discovery: the sky could be divided into two distinct sets of directions.

The first set, which we will refer to as "region A," consists of directions where numerous galaxies appear in front of more distant galaxies. The second set, "region B," comprises directions where distant galaxies are observed without any foreground galaxies obstructing the view. These findings highlight a peculiar asymmetry in the distribution of galaxies and suggest that the universe's expansion may not be uniform in all directions. This unexpected division of the sky into region A and region B prompts further investigation into the underlying causes and implications for our understanding of cosmological models.

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[2] The derivation of an elegant distance formula is simple, and we do not need to expose it here.

Galaxies are at such great distances from each other that they cannot interact as if inside a balloon being inflated. Therefore, according to the amateur astronomer, the issue likely lies in the nature of redshifts. He proposed that the measured redshifts of distant galaxies, which form the basis of the standard Big Bang model of cosmology, might not be related to the expansion of the universe at all. Instead, they could be caused by a completely different effect: the aging of electromagnetic radiation as it travels through space. Historically, this idea has been referred to as "tired light."

Our amateur astronomer asserted that the redshifting of light (electromagnetic radiation) occurs according to accepted physical laws and is similar to many other natural phenomena. In nature, whenever something moves, there is always something else that resists this movement. Such impeding forces also exist in outer space. The amateur astronomer believed that as light travels through the vast distances between galaxies, the redshift effect begins to appear. He associated this effect with the hypothesis of the aging (or energy reduction) of light.

He suggested that light loses energy as it crosses the vast expanses of space, encountering forces that absorb its energy, such as the ether. The older the light, the more redshifted it becomes. Therefore, the redshift of galactic light would be proportional to the distance the light travels, rather than any other factor. Based on this conclusion, the amateur astronomer described the universe as a non-expanding structure where galaxies are more or less stationary.

The paradox with regions A and B, which differ fundamentally from the Big Bang model, can be explained based on Mullat's 2016 postulate. This postulate asserts that starting from a state described by the singularity of space, the space suddenly inflates from an infinitesimally small hole created by a seed of hidden vacuum or vacuum glue during a gravitational transition into static space from the Background Energy-Vector-Field region. This seed might be as small as a Planck wall or even smaller.

According to this perspective, when a "lump of space" emerges, it imposes additional pressure on the previously "super-cooled or latent gravitational energy," causing further inflation. This process is likened to an avalanche rolling down a hill and gaining mass (and therefore weight) due to the potential gravitational energy of the super-cooled or latent energy field, thereby creating additional space.

Hereby, no like Big Bang explosion is assumed, while the formation of new galaxies is consistent with the steady state theory. The postulate suggests the creation of new areas of dark matter or hidden vacuum, or vacuum glue, from the Background Energy-Field, from which galaxies will then form. If we further assume that the average absorbtion coefficient decrease of the background vector-field energy density of the expanding three-dimensional globe (or manifold), as the radius of the globe of newly formed galaxies increases, then it becomes clear that the terrestrial observer will see exactly what our amateur astronomer described.

If the front of galaxy formation passed the terrestrial observer around 4 billion years ago and has continued to move further as the radius of the globe grew, then the observer's view in terms of the energy absorbtion coefficient density of newly created galaxies should indeed be divided into two hemispheres: one with a lower density of matter (energy) and one with a higher density of matter. Therefore, it is not surprising that astronomers might observe different Hubble constants depending on which side of the sky their telescopes are pointing.

Indeed, recent research indicates differences in galactic distribution between the northern and southern hemispheres of cosmological observation, revealing unexpected large-scale asymmetries. These asymmetries include variations in galaxy spin direction, clustering patterns, and other structural differences that seem to defy the assumption of isotropy—the idea that the Universe should appear uniform in all directions on large scales.

For example, studies of galaxy spin directions show a significant difference between galaxies in the southern hemisphere and those in the northern hemisphere. Specifically, a preference for certain spin directions in one hemisphere suggests an underlying large-scale cosmic asymmetry. Such findings challenge the long-held Copernican principle, which posits the Universe's large-scale uniformity. New evidence and analysis of cosmological-scale asymmetry in galaxy spin directions, Journal of Astrophysics and Astronomy, https://link.springer.com/article/10.1007/s12036-022-09809-8 (accessed, 19.09.2024), Large-scale asymmetry in galaxy spin directions: evidence from the Southern hemisphere, Publications of the Astronomical Society of Australia, Cambridge Core (accessed, 19.09.2024), https://www.cambridge.org/core/journals/publications-of-the-astronomical-society-of-australia/article/largescale-asymmetry-in-galaxy-spin-directions-evidence-from-the-southern-hemisphere/F8E14D4B82FE25838C796F66CCAEE30A.

In addition to spin asymmetry, differences in the density and distribution of galactic structures across hemispheres have been observed. Surveys like the Sloan Digital Sky Survey (SDSS) and the Dark Energy Survey (DES) have contributed to mapping these variations, further highlighting regions of the sky with unexpectedly dense or sparse distributions of galaxies, which could point to underlying differences in cosmic expansion or gravitational influences; The Distribution of Galaxies in Space, (accessed, 19.09.2020), https://courses.lumenlearning.com/suny-ncc-astronomy/chapter/the-distribution-of-galaxies-in-space/.

5. Concluding remarks

In conclusion, several important observations can be made. Our experiment involved evaluating two novel methods for calculating distances to cosmological objects and comparing these methods with the well-established Hubble diagram formula. To achieve this, we collected data from publicly available sources on the comoving angular diameters of quasar pairs. Each apparent diameter was measured as a visible angle in a spherical coordinate system, expressed in kpc per arc-second. This allowed us to accurately compare our calculations with the Hubble diagram using online data for pairs of quasars.

We believe we have demonstrated the applicability of these two new methods for calculating distances to cosmological objects. However, it is important to note that this does not invalidate the numerous positive theoretical results obtained using the Hubble law for estimating distances to space objects. Nonetheless, our findings suggest that measurements of distances to cosmological objects can still lead to contentious scientific conclusions in cosmology, such as those related to the Big Bang theory.

The accuracy of experiments, particularly in estimating distances to distant cosmological objects like quasars, is of paramount importance. Frequently, different research groups present conflicting measurements, leading to debates within the scientific community. Additionally, many observational data in cosmology are deemed questionable or unreliable, often due to significant standard deviation errors, which imply a high probability of inaccuracies. In contrast, our experiment demonstrated a very low probability of error.

From these observations, a critical conclusion emerges: the reliability of the Doppler effect and Hubble's law for calculating distances to cosmological objects remains highly questionable. It is essential to highlight that astronomical observation databases invariably incorporate the Hubble diagram, either explicitly or implicitly, since these databases contain velocities of objects calculated based on the Doppler effect. Thus, applying the Hubble diagram to projections that inherently reflect the Hubble diagram results in a repetitive confirmation of the Hubble diagram itself.

From this perspective, the two independent calculation methods we employed can be trusted more, as they rely on a single parameter—the redshift. This aspect underscores the unique contribution of our experiment, which highlights the complexity of measuring distances to cosmological objects. It raises the fundamental question of whether to continue using the Hubble diagram or to adopt alternative methods for calculating distances to cosmological objects. Our findings suggest that alternative methods may offer more reliable and less error-prone distance estimates, thereby contributing to a more nuanced understanding of the universe.

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Prospects

POSTSCRIPT

Astronomers do not observe the entire Univers, but their observations have been sufficient to propose reasonable conclusions that challenge the standard Big Bang model. Addressing the thoughtful reader, we present two contrasting yet similar scenarios on the dynamics of matter in the Univers.

The first scenario proposes a theoretical model based on the contentious notion of ether. Despite the Michelson–Morley experiment suggesting the non-existence of ether, the significance lies in the methodology for the creation of matter in the Univers from strings of so-called Pan Particles comprising the ether.

The identity of these particles is less important than their behavior: they double in number over long periods while gradually decreasing in size, maintaining a constant density relative to the space they occupy. Consequently, matter in the Univers also reduces in size while proportionally increasing in number. This approach, based on Pan Particles, allows distances to galaxies to be calculated using Euclidean geometry and a simple formula.

In summary, this scenario provides an alternative view of the Univers's development, proposing that matter arises from ether or from a gravitational transition of the Background Energy Field into visible matter and dark vacuum or vacuum glue.

This theoretical framework suggests that the Univers's structure and expansion can be understood without invoking an expanding space metric, aligning more closely with a static univers model. From a mathematical scenario, this situation could be represented as an expanding metric of space. This space could be filled with the controversial ether, Pan Particle substance, or new matter according to the postulate of gravitational transition from the Background Energy Field. However, our knowledge of these entities remains theoretical and hypothetical.

It should be noted that the incredibly slow reduction in the size of matter throughout the Univers over time could be attributed to the expansion of space rather than an actual reduction in matter's size. These scenarios are relative and can be seen as different interpretations of the same phenomenon. This concept is analogous to Jonathan Swift's Gulliver's Travels, where Gulliver encounters giants who appear enormous compared to him. Similarly, in astronomy and astrophysics, when we observe the most distant galaxies, we are like Lilliputians looking back in time to the land of giants. Neither modern Lilliputians nor the giants of the past would notice changes in their size, the objects surrounding them, their tools, or the relative size of their habitat because they all use the same rods, meters, and kilograms for measurement. These measurements shift with the increase in redshift (z), accompanied by an exponential increase in the linear dimensions of atoms.

When discussing the second scenario on the creation of space, our thoughtful reader might notice an apparent contradiction: in one approach, the density of the so-called "hidden vacuum" and visible (baryonic) matter decreases, while in the other, the density is presumably fixed. This difference may seem fundamental in the approaches to matter formation. However, there is no real contradiction, as both scenarios consider a static Univers model. For example, if we weigh 1 kg of metal freshly cast from a blast furnace, it will still weigh 1 kg whether it is hot or cooled. However, in terms of energy density (or substance density), that same kilogram of metal has less energy density when cooled than when it was in the blast furnace.

It is reasonable to assume that the birth of matter—whether in the form of particles, atoms, or Pan Particles—occurred at a very high energy level within the Background Field, or perhaps within a Vector-Energy field. As the Universe evolves, the local energy of matter decreases, yet the total energy of matter remains constant. This distinction between total energy and the distribution of local energy resolves the apparent contradiction and aligns the models of both scenarios, despite their different focal points. While the local energy decreases, the total energy of the Universe, as observed by astronomers, remains constant in both approaches.

As the Univers develops based on the postulate of matter emergence, it is assumed that matter arises from a gravitational transition of the Background Energy-Vector Field—first into hidden vacuum and then into visible anti-vacuum or baryonic matter. Therefore, how we label the Background Field—whether as ether, gravitons, or any other term—is irrelevant. The naming does not alter the essence of the gravitational transition phenomena or the creation of Pan Particles.

Unlike well-known geometric models where events typically occur, it should be noted that in the second scenario, the gravitational transition of the Energy-Vector-Field into matter occurs within a three-dimensional Euclidean surface, specifically a stereographic projection of a four-dimensional globe. This offers a novel viewpoint on the formation of matter in the Univers and aligns with the theoretical models proposed in both narratives. The justification for the proposed postulate regarding the gravitational origin of matter in the Univers was the focus of our efforts in both approaches. We did not delve into the physical theories concerning the nature of the gravitational field's transition into matter. Instead, we simply posited that one form of matter transforms into another: the Energy-Vector Field of gravity transforms into dark or hidden vacuum (hidden glue) and visible matter. It is also important to recognize that systems for measuring the space occupied by matter in various forms require different metric units, such as cubic meters, kilograms, lengths, and so on.

Typically, to substantiate theories, physics relies on laboratory experiments, which, for obvious reasons, cannot be conducted in cosmology. However, it is possible to use existing databases and published literature to compare data tables against which different theoretical models can be tested. In this context, it was possible to calculate the theoretical distances to cosmological objects based on their redshift using three models. Although some researchers, like Halton Arp, consider redshift an unreliable indicator for calculating distances, we currently lack a definitive alternative that could serve as a better indicator.

In the second scenario, we developed a method for calculating distances to cosmological objects based on our postulate of gravitational transition. This method was fine-tuned using the NED database, where many objects are listed with distances that are allegedly independent of redshift. We attempted to compare our calculation method with the PAN theory distance formula. Additionally, we compared distances derived from the hypothesis of an expanding Univers, consistent with Big Bang phenomena, against the standard Hubble diagram. It should also be noted that the data used in this approach, sourced from literary references available online, reflect the views of a limited group of researchers.

The outcomes appear satisfactory to us. Calculating distances to cosmological objects based on the gravitational transition postulate yields numerical values similar to those from the PAN theory, though adjustments are required for the Hubble diagram. Our findings suggest that the steady-state model of the Univers might be more realistic than the Big Bang model. Furthermore, addressing contradictions—particularly those related to the horizon problem and Halton Arp's observations—helps to resolve many of these discrepancies.

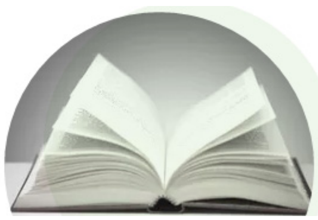
General relativity, a theory grasped by only a select few, is grounded in the geometric nature of space. However, it faces challenges in explaining the observed expansion of space, particularly when considering acceleration driven by a hypothetical Energy-Vector-Field. This complexity might give readers the impression that our cosmological discussions further obscure the concepts of space and time by introducing terms like "hidden vacuum" and "Background Energy-Field." While our cosmological reasoning seeks to address modern physics puzzles, our ultimate goal is to showcase the potential of combinatorial mathematics through the lens of differential geometry, especially in the context of monotone systems. By providing examples, we aim to make these discussions engaging and accessible, similar to a layman's pedagogical approach.

Indeed, Newton's laws and General Relativity are not required for our model of the Universe's creation, which relies solely on geometry with parameters x, y and z. Time is also unnecessary in this framework. Since 2016, we have been able to precisely predict the measurements from the Planck Mission regarding the distribution of components: 4.9% visible matter, 26.8% dark matter (whose nature remains unknown), and 68.3% dark energy (a mysterious form of energy). This was achieved using a Γ-equation. While this equation cannot predict the movements of cosmological objects (as time is not part of our model), the Push Gravity theory allows us to construct a scale for the Energy Vector-Field absorption coefficient κ in the interval $[0.08726762,...,\infty]$. Currently, the Universe is at $\kappa = 0.12457$. Note the term "current"; κ may act as a time indicator. Indeed, by comparing two states of the universe with different κ values, such as $\kappa_1 > \kappa_2$, we can state that the universe is presently at $\kappa = 0.12457$. Initially, it was at $\kappa \approx \infty$, and in the "future", it will approach a death state at $\kappa^* \approx 0.08726762$. In this death state, the Vector Energy-Field will be exhausted, and gravity will be at its lowest level, according to Push Gravity theory absorbtion coefficient. This signifies that the phase transition of the energy vector field into matter will cease.

In conclusion, it is important to highlight the application of Monotone Systems, or Monotone Phenomena, in geometry as discussed in the second scenario. There is no need to delve deeply into the complexities of modern physics, particularly the intricacies of time and space. Although the physical examples used to illustrate the material—such as "Potential Energy of the Avalanche," "Super-cooled Water," or "The Tale of the Creation of Matter"—may seem random, they are purposefully selected. While these examples might initially appear unrelated to the model of stereographic projection, they uncover the hidden aspects of Monotone Phenomena.

Monotone phenomena facilitate the mapping of sub-manifolds of Euclidean space, enabling the introduction of fixed points for these mappings, akin to Brouwer's theorem in topology. Although general methods for calculating Brouwer's fixed points are lacking, our approach provides an advantage in determining fixed points for Monotone Phenomena mappings. Methods from differential geometry are valuable here, as they allow for the calculation of potential functions and the formulation of equilibrium equations. Even if the equilibrium solution lacks direct physical significance, this novel approach sheds light on phenomena arising from the property of monotonicity.

We anticipate that further research into Monotone Phenomena will deepen theoretical understanding and contribute to the development of more effective algorithms for finding optimal solutions. The approach to steady states, or stable sets, demonstrated in the third narrative holds significant promise for future exploration. By offering diverse scenarios on various subjects, whether in atomic or continuous forms, we aimed to uncover important phenomena that are often overlooked. Our goal was to present evidence that highlights opportunities for those interested in advancing science through open-minded inquiry and dedicated effort.



Evidently we have to acquire knowledge of the original causes (for we say we know each thing only when we think we recognize its first cause), and causes are spoken of in four senses. In one of these we mean the substance, i.e. the essence (for the 'why' is reducible finally to the definition, and the ultimate 'why' is a cause and principle); in another the matter or substratum, in a third the source of the change, and in a fourth the cause opposed to this, the purpose and the good (for this is the end of all generation and change). We have studied these causes sufficiently in our work on nature, but yet let us call to our aid those who have attacked the investigation of being and philosophized about reality before us. For obviously they too speak of certain principles and causes; to go over their views, then, will be of profit to the present inquiry, for we shall either find another kind of cause, or be more convinced of the correctness of those which we now maintain.

By Aristotle, 350BC

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