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Original Article

The Nature of Universe

Marek S. Żbik

Faculty of Geology, University of Warsaw, ul. Żwirki Wigury 93, 02-089 Warsaw, Poland.

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Abstract *- The article discusses the problem of the nature of the universe probably troubled people's minds from the moment when abstract thinking gave rise to reflecting on meaning existence. We have abundant evidence of this left by humans since prehistoric immemorial records dating back to the ancient and medieval Stonehenge era. the man slowly managed to find a rational explanation of some mysteries of nature and determine the laws of nature formulated, among other things, by Aristotle, Pythagoras, and Archimedes. Using these discovered laws written in the form of mathematical equations made it impossible to predict certain events and better understand the mechanism before born of quantum mechanics. in the new view of modern science, the universe is an energy-fluctuating spacetime from which elementary particles of matter are still emerging and disappearing, buildings the blocks of the world around us, including ourselves. the most fundamental level universe may consist entirely of time fluctuations on the Planck scale within the spacetime frame. Observation of clusters of galaxies across the observable universe reveals a highly porous cellular structure containing large-sized voids entwined with fibrous threads made of galactic beads intertwined by invisible forces into a "Cosmic Web". It is proposed that this type of structure, often found in colloidal solutions, may result from electromagnetic interactions rather than from gravitational interactions alone.*

Keywords *- Universe, Quantum fields, Time fluctuation, Black holes, The multiverse.*

I. INTRODUCTION

The problem of the nature of the universe probably troubled people's minds from the moment when abstract thinking gave rise to reflect on the meaning of existence. We have abundant evidence of this left by humans since prehistoric times dating back to the Stonehenge era, ancient and medieval records (Fig. 1). It was almost always associated with views of a religious nature. Beliefs were the basis for forming consciousness, which built successively evolving worldviews. Slowly, the man managed to find a rational explanation of some of the mysteries of nature and to define the laws of nature formulated, among others, by Aristotle, Pythagoras, and Archimedes. Using these discovered laws written in mathematical equations, we managed to predict certain events and better understand the mechanism, i.e. the nature of the universe around us.

Fig. 1 Camille Flammarion (1888), a lithograph from the book, shows the image of the universe and its boundaries

Over the last three centuries, progress in understanding this nature of the universe has been extremely rapid, as evidenced by the monumental works of Copernicus, Galileo, Newton, and Maxwell. However, only the progress of the last century can be considered astonishing. Completely revolutionary theories emerged, such as Albert Einstein's theory of relativity and quantum mechanics invented by Werner Heisenberg (Heisenberg, 1925) and were rapidly developed thanks to the work of Max Born (1926) and Paul Dirac (1928). At the beginning of the 20th century, these discoveries resulted in a very increasing number of still new and creative ideas deepening our understanding of the universe and causing confusion resulting from the rapidly changing paradigms of science. One of the newest ideas born in the second half of the twentieth century was string theory, developed thanks to the works of Gabriele Veneziano, Leonard Susskind (2005), and Yoichiro Nambu (in Pesic, 2014), assuming that the building blocks of the universe were not so far assumed to be point particles, but two-dimensional strings 10^{-31} meters in size stretched in at least ten-dimensional spacetime. However, the evolution of this revolutionary string concept took place very quickly.

Despite the initial successes of the string concept, there were still many problems for physicists that string theory could not solve. One of the deepest problems, as it turned out, was the problem of quantum gravity. General relativity (Einstein, 1905) is formulated in classical physics, while other fundamental forces are already described in the framework of quantum mechanics. To reconcile general relativity with the principles of quantum mechanics, a quantum theory of gravity was needed, which was not what string theory could do. Difficulties arose when attempts were made to apply the usual rules of quantum theory to the force of gravity. Besides the problem of developing a coherent theory of quantum gravity, there are many other fundamental problems in the physics of atomic nuclei, black holes, and the so-called early universe.

Before 1995, there were attempts to salvage the situation with the idea of five coherent versions of superstring theory. This understanding changed in 1995 when Edward Witten (1995) suggested that these five theories were just special cases of an 11-dimensional theory called M-theory. This led to a violent research activity known as the Second Superstring Revolution.

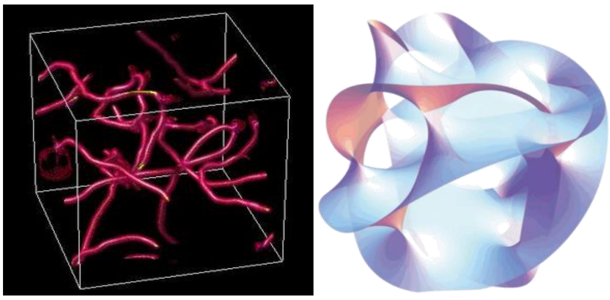

Fig. 2 Topology of cosmic strings in spacetime, and the six spatial dimensions coiled into a Calabi-Yau manifold (Wikipedia).

The matrix model was proposed in 1997 as equivalent to the M-theory. This model could therefore be used as a prototype for the correct formulation of M-theory and a tool to study the properties of M-theory in a relatively simple model. A common way to derive real physics from string theory is from heterotic string theory in ten dimensions, assuming the curl of the six excess space dimensions into a shape resembling a Calabi-Yau (Yau & Nadis, 2010) six-dimensional manifold (Fig. 2). Calabi-Yau, manifolds offer many ways to derive real-world physics from string theory. String theory is a two-dimensional conformal field theory: a type of quantum field theory. Quantum field theories are not necessarily strung theories. More specifically, the ontology of string theory is very different from quantum field theories, but the theoretical machinery is essentially the same. As can be seen from this, theoretical physicists delving into the incomprehensible complexity of the nature of the universe on its quantum scale have great difficulties in adjusting its mathematical image to the real world that we observe in the macro-world. So how does this complexity of the nature of space on the Planck scale relate to the nature of the universe we observe?

An important problem with string theory is that to construct particle physics models based on this theory, physicists must determine the shapes of the additional dimensions of spacetime. Each shape corresponds to a different possible universe or "vacuum state" with a different set of particles and forces. in the understanding of string theory, this concept is characterized by the enormous number of these vacuum states, usually estimated to be around 10^{500}, which can be varied enough to account for almost every phenomenon observable under these particular vacuum states.

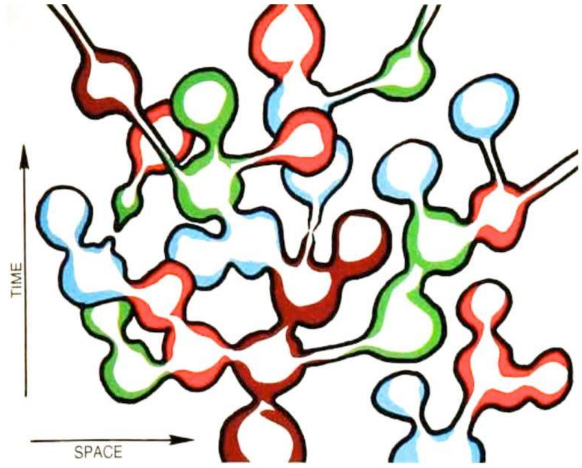

Fig. 3 Multiverse, according to Smolin

This reasoning led to the concept of multiverse developed by Lee Smolin (2019) and Andriey Linde (1998) into a kind of super-universe within the boundaries of which this immeasurably large number of universes exists, and each of them is to be different from all others (Fig. 3). Moreover, there is no objection that there are also completely identical universes in this enormous set, which would multiply the infinite number of possible and coexisting universes of this inconceivably enormous universe.

What, then, is this infinite nature of all things? As seen from the cursory gymnastics of the best minds over the eons, the answer can be neither simple nor final. the universe with this simple expression defined in astronomy over time many things understood today as the universe. We now understand this term as a complete collection of all things that we can perceive with our senses, and by using more and more complex instruments that are perfect prostheses for our imperfect ones, as we have already repeatedly found out about the senses that cannot perceive 95% of the universe. For justification, these senses were shaped in the environment from which we grew up, and evolutionarily, they were not intended to embrace all things. Thus, the meadows, cities, seas, and mountains of the near and distant land were those collections of things as the world appeared from time immemorial. Hence, it was needed to use prostheses. One of the first of which was the telescope invented by Galileo. the invention has considerably expanded the boundaries of all things. Ever since Galileo invented a telescope for astronomical observations in the early seventeenth century, efforts have been made to determine the pattern and laws by which known celestial bodies coexist in the universe. Initially, data was collected on the distribution of relatively close objects to the solar system. the realization that we are part of a huge cluster of stars called the Galaxy was a breakthrough in understanding the universe as a hierarchically constructed collection of objects of unimaginably large size. It turned out that the Galaxy, which is a collection of about two hundred billion stars and ten times as many planets, which at the beginning of the 20th century was considered the entire universe, is only an extremely small part of it.

Fig. 4 The modern image of a section of the universe on a logarithmic scale

The Earth is again shown here as in the center of the universe. This observation point of the Earth results from the fact that we are in the center of the observable horizon of the universe that surrounds us from all sides. the boundary on this horizon is the microwave background radiation. (Unmismoobjetivo/CC BY-SA 3.0/Wikimedia Commons).

It is now widely believed and well described by Tamara Davis (2004) that the size of the universe's radius is dictated by its age, which is 13.8 milliard years (Gyr) old, which is the age 0, the beginning of our universe. This is also the radius of the nonexpanding universe model, which is 13.8 milliard light-years (Glyr). As a reminder: one light-year is the distance that light travels in a vacuum at ~ 300,000 km/s in a year. the light must travel for about 4 years to the nearest star, α-Centauri. However, as early as 1929, Edwin Hubble showed that the universe is not as stable as previously thought but seems to be expanding. the further space objects are positioned from us, the faster they move away from us. It has been calculated that the expanding speed of the universe increases by 71 km/s/Mpc, or 71 km/s for every million parsecs (1pc ~ 3 light-years). the idea is mainly based on the study of the redshift of the spectra of distant galaxies interpreted based on the Doppler effect but has not yet been confirmed by independent methods.

After accounting for the effect of the so-called expansion of space, the present size of expanding universe is approximately 46 milliard light-years (Glyr) in diameter (Davis, 2004). in such a model, the radius of the universe is understood as the radius of the so-called particle horizon, i.e. the distance from where the rays emitted by the objects that emitted this light after the birth of the universe come to us. This distance of 13.8 Glyr in the non-expanding universe model can be called the event horizon radius of the observable universe.

II. DISCUSSION

However, suppose we assume that beyond this horizon, our universe extends even beyond imaginable distances. in that case, we must realize that the nature of this universe may never be comprehended and understandable for human reason. the diameter of the horizon depends on the speed of light in a vacuum, which may have evolved. Added to this is the multiverse theory that gives the possibility of the existence of an infinite number of similar universes, although not necessarily with properties identical to our universe.

Even if one were to agree with this multiverse concept, the attentive reader might ask, what is space that separates these universes? Do they exist in everything like noodles in a soup? This would mean that they are closed within the space of the super-universe with undefined properties and limits, and what is outside this super-universe, and are they similar to it? Could anything exist in this space between the universes? Or maybe there's nothing even there (even when quantum fields may not exist)? May such a space even theoretically exist? Matter cannot be stably in such an environment.

If one were to assume that this enormous number of universes contains information, then this set is a kind of information fil*e*. Thus, it can be assumed that similar to the computer of each one of us, numerous files of information are stored, so also these individual universes may represent information files arranged similarly to files existing in your computers. the question then arises: What is the space separating information in the supercomputer memory, and how similar can these spaces separating computer files be to those separating individual universes?

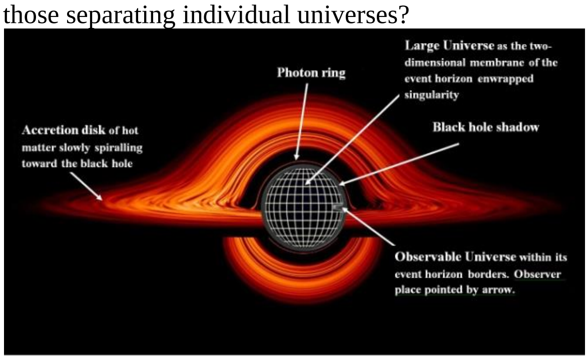

Fig. 5 In the black hole model, the event horizon is embracing singularity

The generally accepted concept of the "Big Bang" by astrophysicists and cosmologists represents a picture of the universe that, as a result of the mysterious process of "inflation", in the blink of an eye grew from the point of Planck size to the gigantic size. It is generally believed that the "Big Bang", which resulted in the birth of the universe, was not an explosion as we can imagine it because it was created out of nothing and with a dimension of time that had not existed before. This type of translation wreaks havoc on the minds of logical readers. the claim that he arose out of nothing is only good for the believers of the Bible. Or maybe somewhere in the background radiation, our universe hid traces of its umbilical cord, which may reveal the secret of its birth?

Some clue may be a suggestion by Stephen Hawking in his popular book "A Brief History of Time" (Hawking, 1996) wherein the chapter on black holes he mentions that the past of the universe was "singularity". Well, "singularity" is a state of spacetime that occurs when a black hole is born (Hawking & Penrose, 1970). the enormous forces acting there destroy the entire known spacetime structure and the baryon matter it contains, thus reducing everything to its most basic quantum form. in the present issue of this contribution, a simple model is discussed, in which the universe was born at the event horizon of “singularity” in a moment when this “singularity” occurred within the mother universe (Żbik, 2020). in the natural course of things, the so-called "event horizon" was formed by enclosing a certain volume of space equal to the Schwarzschild radius around the thus created "singularity" (Fig. 5). It is difficult to say how long such a black hole event horizon may be created, which means inflation in the newborn universe was developed. Still, immediately after the black hole creation, inflation may stop.

The event horizon is a kind of membrane surrounding the black hole and, as it were, cutting off the spacetime inside from the black hole outside so that nothing, not even a ray of light, can escape from inside this object. Thus, the concept of a nascent and evolving universe placed on, or somewhere near this two-dimensional event horizon membrane, as outlined in more detail in the aforementioned (Żbik, 2020), may seem like a simple and logical picture of the formation and evolution of the young universe. Since black holes are common in our universe, it can be assumed that they must have also existed in the mother universe. Thus, the multi-storey edifice of the multiverse may be a natural consequence of this concept. However, a question will arise about this umbilical cord of the most primal universe, on which, probably in the infinitely distant past, the trace was lost.

But what is the nature of our universe and its destiny? It is an illusion to think that whatever is in our immediate surroundings may represent the universe. Unfortunately, it is not the case. These beautiful panoramas of foreign and domestic holiday resorts, cafes, restaurants, entertainment houses, or our families and loved ones, who constitute our universe for most of us, are only an extremely simple and unbelievably negligible small part of it. This piece of our everyday universe is so small that it is negligible and beyond astrophysicists' calculations and may be treated as an anomaly. Can we live in a strange fragment of the universe?

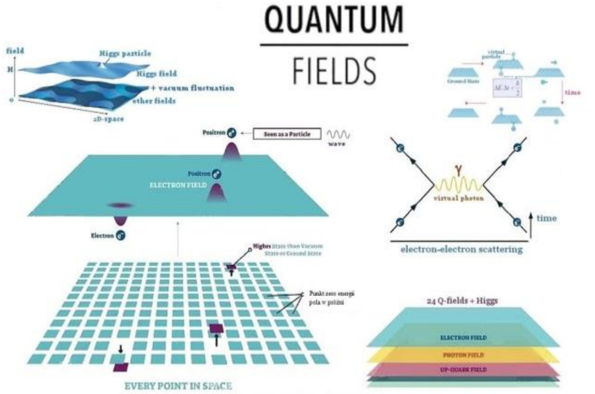

Fig. 6 Visualization of the quantum field permeating spacetime

The universe which surrounds us is an empty, cold place in which, on average, we can get six hydrogen atoms per cubic meter of vacuum. Judging from the mass estimate, a visible matter that makes up stars, planets, gas and dust clouds, and other baryon matter forms, accounts for just five percent of the universe's total mass. This bad or good world that surrounds us is an extremely rare anomaly, and matter made of atoms or ions is also space because, as we have found out, the nucleus of a hydrogen atom is in 99.99999999999996% space.

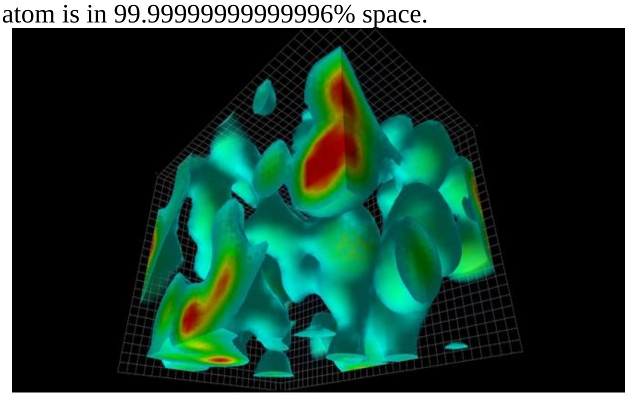

Fig. 7 Planck scale three-dimensional model of vacuum energy fluctuation. (Wikipedia)

The closest to the truth is the answer to the simplest, if it seems, the question of what the universe is; it may be the statement that the universe seen from our point of view is a vacuum filled with quantum fields of spacetime permeating it (Fig. 6). This picture seems to constitute the most basic image of the nature of the universe. Since the discovery made by the Dutch scientist Hendrik Casimir (1948), it has been known that space contains energy. It was called vacuum energy. Thus, quantum fields, the nature and meaning of which the physicist is just guessing, saturated with "vacuum energy", are in a state of constant fluctuation (Fig. 7).

From this boiling soup of spacetime, certain fragments of it, which have obtained sufficiently high energy, for a brief moment and create a virtual pair of elementary particles, for example, an electron and a positron, and then, as a result of the destruction, sink back into the soup quantum fields of apparent space? This is schematically shown in Fig. 6. Virtual particles can become real when they have an energy source to balance the energy debt made by their creators. However, particles such as protons may exist for an unknown period.

Sometimes, for unknown reasons, certain particles remain and do not dissolve again in space, at least for such a time that they can be observed. in his article, Art Hobson from the University of Arkansas stated that "there are no elementary particles of matter, only fields of these particles exist". Perhaps there is even only one field from which particles of different energy emerge, thus giving the impression that there are many quantum fields. in this way, matter in the understanding of baryon particles can be seen as emerging from quantum fields and can constitute a kind of vacuum energy accumulator.

Fig. 8 The artistic vision of the hidden world

Particles condense out of a vacuum when it exceeds a certain energy level threshold and break up, soaking into the vacuum when its energy level drops. Photons, electrons, atoms, molecules, and even apples on your table are ultimately disturbances in several universal quantum fields. We can observe these disturbances and figuratively show them; these disturbances may look like the mane of larger waves on a rough ocean.

The ocean and the waves on it cannot be seen, but the only thing that can be seen is the foam dripping manes piled up on the waves of the highest energy, illuminated against the water's black surface by the moonlight (Fig. 8). Thus, when we move from the fluctuation of the energy of the quantum world to the real world that we feel with our senses, we can see only an extremely tiny fragment of the huge universe hidden from our eyes. So, we are aware that the physical world we are testing around by our senses is only the tip of the iceberg. However, the effect of this invisible majority of the universe, which interacts with material bodies, is responsible for most of the physical phenomena we observe are not well understood yet.

One of these effects is gravity. We feel the weight and mass of the bodies. We deal with this phenomenon every day, and no one has yet found an answer to what gravity is. in the theory of relativity, only Albert Einstein showed that mass causes the curvature of space, and this is felt like the force of gravity and inertia. Thus, it is a fundamental effect of mass interaction with space.

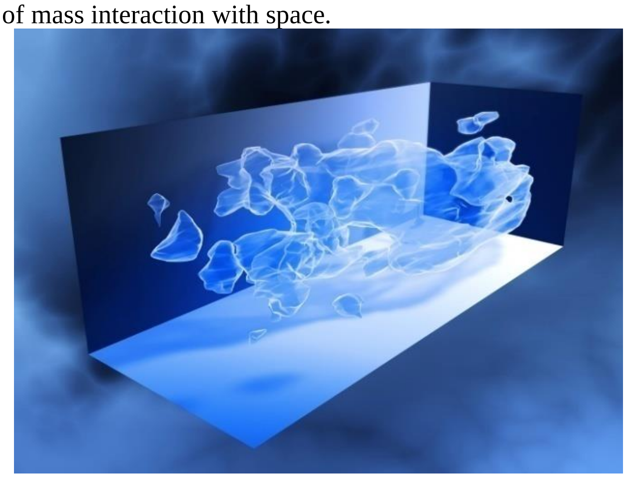

Fig. 9 3D image of the distribution of dark matter obtained in the "Hubble COSMOS survey" (ESA)

However, if we take a closer look at it, we find out that time flows slower than far away in space in the vicinity of the mass. It is possible to imagine that if we could manipulate time and slow down time flow in a given spacetime volume. Such a volume of space would be curved and eventually closed gravitationally, forming the black hole. Thus, this mass-less area would become heavy and attracts massive objects from all surrounding space. This may create a "great attractor" that could cause gravitational lensing of objects further down in the background, as shown in Figure 9.

If Planck units quantize the spacetime, then time must also be so. If time is one of the dimensions of spacetime, then this dimension is also a quantum object and must undergo random fluctuations. in some regions of spacetime in the Planck dimension, the values of the course of time fluctuate, accelerating at one point of the Planck's time frame and slowing down the course of time at another. This behavior affecting the fluctuation up and down of the spacetime curvature may be seen as the quantum field energy generator. Given the vast expanses of the universe, it is likely that the time slowing fluctuation could spontaneously occur on a real volume of the space; thus, simulating the presence of General mass relativity tells us that light will be affected by gravity. This so-called bending of spacetime has been observed in the warped light of a star orbiting the Milky Way's supermassive black hole (SMBH) - Sagittarius A. It also does not seem unlikely that such fluctuation would go deep enough to form a black hole (without the superstar having to collapse so, without singularity occurrence). Such black holes may be created in great numbers in the early stages of the matter-less universe's development when spontaneous fluctuations of the spacetime fabrique could have been very common.

Having all this in mind, could it be possible that out of "nothing", merely the result of sudden and profound fluctuation of time, within spacetime frame in the Planck scale, a completely new universe could arise within the space of the mother universe at the event horizon of the singularity-less black hole? Was this the beginning of the birth of our universe? in the case of the low value of vacuum energy, such a universe may exist without creating elementary particles and cosmic bodies as we observe within our universe. Such an "empty universe" may be populated by singularity-less, primary black holes which emerged from the initial time fluctuation of the universe's birth event.

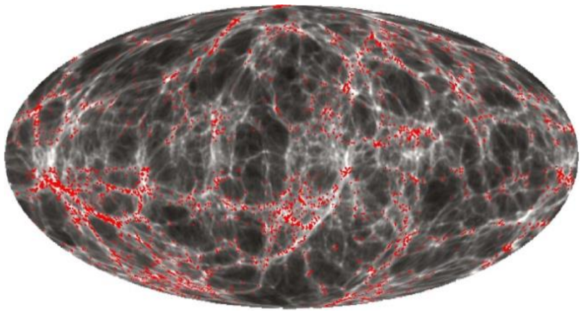

Figure 10. Mollview projection in Galactic coordinates of all galaxies from the 2MRS catalog (Górski 2005).

The four-dimensional map of the Visible Universe created showed a strange, hitherto unknown picture in which galaxies and groups of galaxies connected in their kind of filaments and chains, somewhat like spider webs, form large three-dimensional cells structures, as shown in Figure 10. the magnetic field's existence within galaxies (Fig. 11) and its linking space were shown in numerous investigations like in (Beck, 2016; Górski, 2005; Klein, 2015), which advocate electric charge movement within space. This may be invoked by (Żbik, 2018) that electromagnetic interaction between galaxies may majorly shape the large cellular structure within the observable universe. As seen from the great map of the universe, the present-day observed cellular structure developed over time from galaxies randomly spread within space soon after being shaped to the present-day fibers-like filament formation.

In the last two decades, extensive magnetic fields generated inside galaxies, extending into deep interstellar and intergalactic spaces, have also been discovered. the cosmos is full of ionized matter. Electrically charged plasma is the most common physical state of baryon matter in the universe. Electrically charged stellar wind plasma fills the intra-galactic environment, and powerful jets of charged particles are projected at relativistic velocities perpendicular to the Galaxy's plane from their central region. These plasma streams seem to be part of the exchange of matter and electric charge between galaxies close to each other. All of this shows the universe as a system of electrically interconnected elements.

Fig. 11 Mapping of force lines of a magnetic field in the adjacent spiral galaxy M77, and distribution of magnetic field lines around the dusty ring of a massive black hole in the center of the Galaxy. (NASA, JPL-Caltech and Roma Free University)

Knowledge about the electromagnetic properties of the universe, despite a large amount of incoming data, is still in its infancy and requires intensive study. However, it already seems obvious that electromagnetic forces, being much stronger than gravity, can be the driving force shaping the great structure of the observable universe. Despite such a great difference in power between electromagnetic forces and gravity, many scholars still hold that there is no point in asking ourselves about the relative power between these forces of gravity and electromagnetism. It is also argued that electromagnetism could have a great influence in shaping the distribution of matter in the cosmos only if there would be an inequality of charges between cosmic bodies. So far, no one has directly measured the electric charges of galaxies in space. the strong magnetic fields were discovered in the nebulae inside the Galaxy, in the region of a giant black hole in the galactic center, in the emerging proto-solar and proto-planetary nebulae, and magnetic fields covering entire stretches of galaxies and extending far beyond their boundaries. All these belie the above thesis and prove it indirectly about the flow of electric current inside the galactic medium. Therefore, they advocate the presence of electric charges within all spaces filled with galaxies.

The distinct fibrous structures of the great map of the universe may indirectly indicate that the interactions between galaxies can be electromagnetic. Similar structures in the micro-world of discoidal rigid-elastic mineral particles were observed in colloidal water suspensions (Żbik, 2018). Due to the difference in the dielectric constant between particles/galaxies and the medium in which those bodies were suspended, they may get electric charges and polarize each other at a distance. Electromotive forces combine all these interacting electrically charged bodies into complex fibrous spatial networks (Fig. 12) resembling the filaments-like mega-structure similar to this observed of the great structure of the universe.

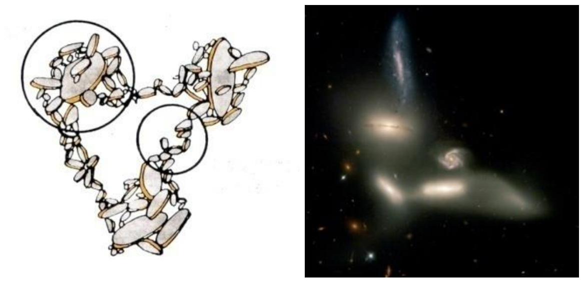

Fig. 12 Model of the formation of a three-dimensional fibrous structure that electrically charged clay minerals build in colloidal solutions of water electrolytes

III. CONCLUSION

So, colloquially speaking, the universe is an energy-fluctuating spacetime from which clouds of known elementary particles of matter are still emerging and disappearing, buildings the world around us, including ourselves, and consists entirely of quantum vacuum fluctuations on the Planck scale.

It was suggested that as a result of sudden and profound fluctuation of time, which would go deep enough to form a black hole within spacetime in the Planck scale. Such an event may create a completely new universe in the space of the mother universe at the event horizon of such a singularity-less black hole.

Thus, in the enormousness of the empty spaces within the cellular structure of the universe, time flows relatively faster than in the mass and energy-rich fibers and nodes where enormous masses of galaxies and their groups create places where time slows down. Thus, the curvature of the space around the fibers and knots will suck up by gravity. the mass that remains in these voids compacts the environment within the fibers and knots. Such mass concentration within fibers and knots further slows down time passage. This can result in a continual increase in void spaces within the observed large cellular structure of the universe. As a result of this, with the additional effect of electromagnetic interaction between galaxies, and in the case of the expanding universe, the so-called by Wiltshire (2013) "timescape" effect may mimic antigravity, in which the empty spaces thinning in matter and energy may accelerate expansion. These effects may attribute to the mysterious power of dark energy.

From the above-outlined concept, it can be assumed that the observed spatial superstructure of the universe presents a highly porous, fibrous medium strung on invisible threads of galaxies' electromagnetic fields is immersed in the spacetime environment of quantum fields of various viscosities. the whole “Cosmic Web” environment along which the electric current flows through the "fibers" builds a gigantic electrically active mechanism of unknown nature and destiny. We constitute an extremely tiny fragment without even realizing it.

One might also wonder if there is a quantum field of life. Quantum fields, as mentioned above, seem to be the most basic component of the universe's matrix. From them emerge elementary particles that are the building blocks of the material world surrounding us. It, therefore, seems likely that the "field of life", if it exists as a result of interaction with organic matter, would create myriads of life forms that could spontaneously exist in every niche on cosmic bodies throughout the universe wherever favorable conditions for life occur. in such an environment, organisms brought to life can emerge from this field to be absorbed into it after death, leaving behind a body as a vessel through which life once flowed. However, these are speculations based on the possibilities this infinite and yet incomprehensible universe offers.

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