Paradigm Shift for Cosmology and Classical Physics

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Abstract

Dirac's themes were the unity and beauty of Nature. He identified three revolutions in modern physics – Relativity, Quantum Mechanics, and Cosmology. In his opinion: "*The new cosmology will probably turn out to be philosophically even more revolutionary than relativity or the quantum theory, perhaps looking forward to the current bonanza in cosmology, where precise observations on some of the most distant objects in the universe are shedding light on the nature of reality, on the nature of matter and on the most advanced quantum theories*" [Farmelo, G. (2009) The Strangest Man. The Hidden Life of Paul Dirac, Mystic of the Atom. Basic Books, Britain, 661p].

In 1937, Paul Dirac proposed the Large Number Hypothesis and the Hypothesis of the variable gravitational "constant," and later added the notion of continuous creation of Matter in the World. The Hypersphere World-Universe Model (WUM) follows these ideas, albeit introducing a different mechanism of Matter creation. In this paper, we show that WUM is a natural continuation of Classical Physics, and can already serve as a basis for a Paradigm Shift for Cosmology and Classical Physics.

Introduction

Today, a growing feeling of stagnation in Physics is shared by a large number of researchers. In some respects, the situation today is similar to that at the end of 19th century, when the common consensus held that the body of Physics was nearly complete. Discoveries of Special and General Relativity, Quantum Physics and Elementary Particles shook that belief and led to a new renaissance in Physics that lasted for a century. The genius of Einstein, Planck, Bohr, Dirac, Heisenberg, and Schrödinger allowed them to propose fundamentally new theories with very little experimental data to back them up.

During the 20th century, their theories were validated and elaborated with newly acquired experimental results. The pendulum may, however, have swung too far: today, all results must be made fit into the existing framework. The frameworks get adjusted when necessary, particularly inconvenient results may even get discarded at times. The time may be ripe to propose new fundamental models that will be both simpler than the current state of the art, as well as open up new areas of research.

In my opinion, there is a principal difference between Physics and Mathematics. I am convinced that Physics cannot exist without Mathematics, but Mathematics must not replace Physics. It is exactly what has happened for the last 100 years. Between 1907 and 1912, A. Einstein wrote: "*Since the mathematicians have invaded the theory of relativity, I do not understand it myself anymore*".

I absolutely agree with John von Neumann who said: "*The sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct, which, with addition of certain verbal interpretations describes observed phenomena. The justification of such a mathematical construct is solely and precisely that it is expected to work".*

WUM is proposed as an alternative to the prevailing Big Bang Model (BBM) of Standard Cosmology that relies on General Relativity. In frames of BBM, the Beginning of the Universe is connected with **Initial Singularity** (**infinite energy density**) and **Cosmological Inflation**, which is a theory of an extremely rapid exponential expansion of spacetime (with practically **infinite speed**) in the early universe up to 93 billion light-years in diameter of the observable universe. The size of the whole universe is unknown, and it might be **infinite in extent**.

The Initial Singularity is a gravitational singularity predicted by General Relativity to have existed before the Big Bang (BB) and thought to have contained all the energy and spacetime of the Universe. From a physical point of view, existence of a mathematical singularity is a drawback of any theory. It means that the theoretical model did not consider some significant physical phenomenon, which prevents an occurrence of the singularity.

In our view, there is no way to prevent an occurrence of the initial singularity in BBM. The **finite World** must have gotten started in a principally different way – a Fluctuation in the Eternal Universe with a **finite size and energy density**. The size of this Fluctuation can increase with a **finite speed**. Then, there is no need to introduce the cosmological inflation. However, a question about the mechanism of Continuous Creation of Matter in the World arises.

F. Hoyle and J. V. Narlikar in 1964 offered an explanation for the appearance of the new matter by postulating the existence of what they dubbed the "Creation field", or just the "C-field". P. Dirac in 1974 discussed a continuous creation of matter by an additive mechanism (uniformly throughout a space) and a multiplicative mechanism (proportional to the amount of the existing matter).

WUM follows the idea of the continuous creation of matter by the additive mechanism, albeit introducing a different mechanism of matter creation. The main differences between BBM and WUM are the existence of the Medium of the World (consisting of protons, electrons, photons, neutrinos, and dark matter particles) and the source of the World's energy – the Eternal Universe.

In our view, we should make use of a number of hypotheses unknown and forgotten by mainstream scientific community in order to elaborate a New Cosmology. Below we will describe the Hypotheses belonging to classical physicists such as Newton, Le Sage, McCullagh, Riemann, Heaviside, Tesla, Dirac, and Sakharov and develop them in frames of WUM. Please pay tribute to these great physicists!

The presented Hypotheses are not new, and we do not claim credit for them. In fact, we are developing the existent Hypothesis and proposing new Hypothesis in frames of WUM. The main objective of the Model is to unify and simplify existing results in Classical Physics into a single coherent picture of a New Cosmology. Many results obtained in WUM are quoted in the current work without a full justification; an interested reader is encouraged to view the referenced papers [1]-[28] (and references therein) in such cases.

Part I. History of Classical Physics

1. Classical Physics before Special Relativity [12] [13] [24]

1.1. Fundamental Physical Constants [12]

Kinetic Theory of Gases explains macroscopic properties of gases, such as pressure, temperature, viscosity, thermal conductivity, and volume, by considering their molecular composition and motion. In 1859, J. C. Maxwell formulated the Maxwell distribution of molecular velocities, which gave the proportion of molecules having a certain velocity in a specific range. This was the first-ever statistical law in Physics that defines macroscopic properties of gases as **emergent phenomena**.

Maxwell's Equations were published by J. C. Maxwell in 1861. He calculated the velocity of electromagnetic waves from the value of the **electrodynamic constant** c measured by Weber and Kohlrausch in 1857 and noticed that the calculated velocity was very close to the velocity of light measured by Fizeau in 1849. This observation made him suggest that light is an electromagnetic phenomenon.

Rydberg Constant R_∞ is a physical constant relating to atomic spectra. The constant first arose in 1888 as an empirical fitting parameter in the Rydberg formula for the hydrogen spectral series. As of 2018, R_∞ is the most accurately measured Fundamental physical constant.

Electron Charge-to-Mass Ratio e/m_e is a Quantity in experimental physics. It bears significance because the electron mass m_e cannot be measured directly. The e/m_e ratio of an electron was successfully calculated by J. J. Thomson in 1897. We define it after Thomson $R_T \equiv e/m_e$.

Planck Constant was suggested by M. Planck as the result of the investigations the problem of black-body radiation. He used Boltzmann's famous equation from Statistical Thermodynamics: $S = k_B \ln W$ that shows the relationship between entropy S and the number of ways the atoms or molecules of a thermodynamic system can be arranged (k_B is the Boltzmann constant). As the result of his analysis, Planck found that the average resonator entropy must be described by a function which depends on the ratios U/ν and U/E at the same time (U is vibrational energy of vibrating resonator). Planck reconciled those two requirements through $E = h\nu$ in which **h represents a factor that converts units of frequency ν into units of energy E.** In 1901, Planck calculated the value of h from experimental data: $h = 6.55 \times 10^{-34}\ J \cdot s$, that is within 1.2% of the currently accepted value. We emphasize that Planck constant, which is generally associated with the behavior of microscopically small systems, was introduced by Planck based on **Statistical Thermodynamics** before Quantum Physics.

Based on the experimentally measured values of the constants R_∞ , R_T , c, h , and the value of permeability of free space: $\mu_0 = 4\pi \times 10^{-7}\ H/m$ we calculate the most important Fundamental constants as follows:

- Basic size unit a :

$$a = 0.5\left[8(\mu_0 h/c)^3\, R_\infty R_T^6\right]^{1/5} = 1.7705641 \times 10^{-14}\ m$$

- Dimensionless Rydberg constant α :

$$\alpha = (2aR_\infty)^{1/3}$$

  It is worth noting that the constant α was later named "Fine-structure constant";

- Mass of electron m_e :

$$m_e = \frac{h}{c}\left[\frac{8R_\infty}{(\mu_0 h/c)^2 R_T^4}\right]^{1/5}$$

- Elementary charge e :

$$e = (2\alpha h/\mu_0 c)^{1/2}$$

All these constants, including classical electron radius $a_o = a/2\pi$, were measured and could be calculated before Quantum Physics.

1.2. History of Dark Matter. Early Ideas [24]

The history of Dark Matter (DM) can be traced back to at least the middle of the 19th century. G. Bertone and D. Hooper provide an excellent review of this history:

- In 1844, F. Bessel argued that the observed proper motion of the stars Sirius and Procyon could only be explained by the presence of faint companion stars influencing the observed stars through their gravitational pull: *If we were to regard Procyon and Sirius as double stars, their change of motion would not surprise us. The existence of numberless visible stars can prove nothing against the evidence of numberless invisible ones* ;
- In 1846, U. Le Verrier and J. C. Adams, in order to explain some persistent anomalies in the motion of Uranus, proposed the existence of a new planet;

- Beside dark stars and planets, astronomers in the 19th century also discussed DM in the form of dark "nebulae". In 1877, A. Secchi wrote: *Among these studies there is the interesting probable discovery of dark masses scattered in space, whose existence was revealed thanks to the bright background on which they are projected. Until now they were classified as black cavities, but this explanation is highly improbable, especially after the discovery of the gaseous nature of the nebular masses* ;
- As soon as astronomical photography was invented, scientists started to notice that stars were not distributed evenly on the sky. Dark regions were observed in dense stellar fields. In 1894, A. Ranyard wrote: *The dark vacant areas or channels running north and south, in the neighborhood of [θ Ophiuchi] at the center .... seem to me to be undoubtedly dark structures, or absorbing masses in space, which cut out the light from the nebulous or stellar region behind them* ;
- In 1904, Lord Kelvin was among the first to attempt a dynamical estimate of the amount of dark matter in the Milky Way (MW). His argument was simple yet powerful: if stars in MW can be described as a gas of particles, acting under the influence of gravity, then one can establish a relationship between the size of the system and the velocity dispersion of the stars: *It is nevertheless probable that there may be as many as* 10^9 *stars (within a sphere of radius* 3.09×10^{16} *km) but many of them may be extinct and 10 dark, and nine-tenths of them though not all dark may be not bright enough to be seen by us at their actual distances. [...] Many of our stars, perhaps a great majority of them, may be dark bodies* ;
- H. Poincare was impressed by Lord Kelvin's idea of applying the "theory of gases" to the stellar system of MW. In 1906, he explicitly mentioned "dark matter" and argued that since the velocity dispersion predicted in Kelvin's estimate is of the same order of magnitude as that observed, the amount of dark matter was likely to be less than or similar to that of visible matter.

1.3. Nebular Hypothesis [13]

The most widely accepted model of Solar System (SS) formation, known as the Nebular hypothesis, was first proposed in 1734 by E. Swedenborg and later elaborated and expanded upon by I. Kant in 1755. This hypothesis maintains that 4.6 billion years ago, SS formed from the gravitational collapse of a giant molecular cloud, which was light years across. Most of a mass collected in the Centre, forming the Sun; the rest of a mass flattened into a protoplanetary disc, out of which the planets and other bodies in SS formed.

The Nebular hypothesis is not without its critics. In his "The Wonders of Nature", V. Ferrell outlined the following counter-arguments:

- It contradicts the obvious physical principle that gas in outer space never coagulates; it always spreads outward;
- Each planet and moon in SS has unique structures and properties. How could each one be different if all of them came from the same nebula;
- A full 98 percent of all the angular momentum in SS is concentrated in the planets, yet a staggering 99.8 percent of all the mass in SS is in our Sun;
- Jupiter itself has 60 percent of the planetary angular motion. Evolutionary theory cannot account for this. This strange distribution was the primary cause of the downfall of the Nebular hypothesis;
- There is no possible means by which the angular momentum from the Sun could be transferred to the planets. Yet this is what would have to be done if any of the evolutionary theories of SS origin are to be accepted.

Lunar Origin Fission Hypothesis was proposed by G. Darwin in 1879 to explain the origin of the Moon by rapidly spinning Earth, on which equatorial gravitative attraction was nearly overcome by centrifugal force.

Part II. Bing Bang Model

2.1. Special Relativity [Wikipedia]

The principle of relativity dates back to Galileo and was incorporated into Newtonian physics. However, in the late 19th century, the existence of electromagnetic waves led some physicists to suggest that the universe was filled with a substance they called "**Aether**", which, they postulated, would act as the medium through which these waves, or vibrations, propagated. An Aether was thought to be an **absolute reference frame** against which all speeds could be measured and could be considered fixed and motionless relative to Earth or some other fixed reference point. The Aether was supposed to be sufficiently elastic to support electromagnetic waves, while those waves could interact with Matter, yet offering no resistance to bodies passing through it. The results of various experiments, including the Michelson–Morley experiment in 1887, led to the theory of **Special Relativity** (SR) that is a scientific theory regarding the relationship between space and time. In 1905, A. Einstein based a work on SR on two postulates:

- The laws of physics are invariant (that is, identical) in all **inertial frames of reference** (that is, frames of reference with no acceleration);
- The **speed of light in vacuum** is the same for all observers, regardless of the motion of the light source or observer.

Lorentz invariance is the essential core of Special Relativity. Einstein's solution was to discard the notion of an "Aether" and the absolute state of rest. In relativity, any reference frame moving with uniform motion will observe the same laws of physics. In particular, the speed of light in vacuum is always measured to be c , even when measured by multiple systems that are moving at different (but constant) velocities.

2.2. General Relativity [Wikipedia]

General Relativity (GR) is a geometric theory of gravitation published by A. Einstein in 1915 and is a current description of gravitation in modern physics. It generalizes SR and refines Newton's law of universal gravitation, providing a unified description of gravity as a geometric property of **four-dimensional spacetime**.

The Einstein's field equations are nonlinear and considered difficult to solve. But in 1916, K. Schwarzschild found the first non-trivial exact solution to the Einstein field equations, the Schwarzschild metric. This solution laid the groundwork for the description of the final stages of gravitational collapse, and the objects known today as Black Holes (BHs).

In 1917, Einstein applied his theory to the universe as a whole, initiating the field of relativistic cosmology. He assumed a static universe, adding a new parameter to his original field equations—the cosmological constant—to match that observational presumption. By 1929, however, the work of Hubble and others had shown that our universe is expanding. This is readily described by the expanding cosmological solutions found by Friedmann in 1922, which do not require a cosmological constant. Einstein later declared the cosmological constant the biggest blunder of his life.

2.3. Big Bang Model [7] [15] [16] [24] [26]

The framework for BBM relies on GR and on simplifying assumptions such as homogeneity and isotropy of space. The Lambda Cold Dark Matter (ΛCDM) model is a parametrization of BBM in which the universe contains three major components: first, a Cosmological constant Λ associated with dark energy; second, a postulated Cold Dark Matter; and third, Ordinary matter.

Dark Matter. G. Bertone and D. Hooper provide an excellent review of DM along with BBM:

- In the wake of the failures of hot DM, it was quickly becoming appreciated that cold DM could do a much better job of accounting for the observed patterns of large-scale structure. In 1984, G. Blumenthal, S. Faber, J. Primack, and M. Rees wrote: "*We have shown that a universe with ~10 times as much cold dark matter as baryonic matter provides a remarkably good fit to the observed universe. This model predicts roughly the observed mass range of galaxies, the dissipational nature of galaxy collapse, and the observed Faber-Jackson and Tully-Fisher relations. It also gives dissipationless galactic halos and clusters. In addition, it may also provide natural explanations for galaxy-environment correlations and for the differences in angular momenta between ellipticals and spiral galaxies*";
- Although the term WIMPs (weakly interacting massive particles), as coined by G. Steigman and M. Turner in 1984, was originally intended to include all particle DM candidates, including axions, gravitinos, etc., a definition of this term has since evolved to denote only particles that interact through the weak force;
- By the end of the 1980s, the conclusion that most of the mass in the Universe consists of cold and nonbaryonic particles had become widely accepted, among many astrophysicists and particle physicists alike. **Cold dark matter in the form of some unknown species of elementary particle had become the leading paradigm.**

The ΛCDM model is based on **six parameters**: baryon density, dark matter density, dark energy density, scalar spectral index, curvature fluctuation amplitude, and reionization optical depth. The values of these six parameters are mostly not predicted by current theory; other possible parameters are fixed at "natural" values e.g. total density equals to 1.00, neutrino masses are small enough to be negligible. The ΛCDM model can be extended by adding cosmological inflation. It is frequently referred to as the Standard Model of BB cosmology, which too is a classical model. The Four Pillars of the Standard Cosmology (SC) are as follows:

- Expansion of the Universe;
- Origin of the cosmic background radiation;
- Nucleosynthesis of the light elements;
- Formation of galaxies and large-scale structures.

2.3.1. Expansion of the Universe

There is now excellent evidence for Hubble's law which states that the recessional velocity v of a galaxy is proportional to its distance d from us, that is, $v = Hd$ where H is Hubble's constant. Projecting galaxy trajectories backwards in time means that they converge to a cosmological Singularity at $t = 0$ that is an infinite energy density state. This uncovers one of the shortcomings of SC– the Horizon problem: *Why does the universe look the same in all directions when it arises out of causally disconnected regions? This problem is most acute for the very smooth cosmic microwave background radiation.*

This problem was resolved by introduction of Cosmological Inflation, which is a theory of an extremely rapid exponential expansion of space in the early universe. This rapid expansion increased the linear dimensions of the early universe by a factor of at least 10^{26}, and so increased its volume by a factor of at least 10^{78}. The inflationary epoch lasted from 10^{-36} s after the conjectured BB singularity to some time between 10^{-33} and 10^{-32} s after the singularity. Following the inflationary period, the universe continued to expand, but at a slower rate.

"*It's a beautiful theory*, said Peebles. *Many people think it's so beautiful that it's surely right. But the evidence of it is very sparse*". According to Silk, *our best theory of the beginning of the universe, inflation, awaits a definitive and falsifiable probe, in order to satisfy most physicists that it is a trustworthy theory.*

Our basic problem is that we cannot prove the theory of inflation is correct, but we urgently need to understand whether it actually occurred .

E. Conover in the paper "Debate over the universe's expansion rate may unravel physics. Is it a crisis?" outlined the following situation with the measurements of an expansion rate of the universe:

- *Scientists with the Planck experiment have estimated that the universe is expanding at a rate of 67.4 km/s Mpc with an experimental error of 0.5 km/s Mpc;*
- *But supernova measurements have settled on a larger expansion rate of 74.0 km/s Mpc, with an error of 1.4 km/s Mpc. That leaves an inexplicable gap between the two estimates. Now "the community has started to take this [problem] extremely seriously," says cosmologist Daniel Scolnic of Duke University, who works on the supernova project led by Riess, called SH0ES;*
- *It's unlikely that an experimental error in the Planck measurement could explain the discrepancy. That prospect is "not a possible route out of our current crisis," said cosmologist Lloyd Knox of the University of California, Davis.*

L. Verde, T. Treu, and A. G. Riess gave a brief summary of the "Workshop at Kavli Institute for Theoretical Physics, July 2019". It is not yet clear whether the discrepancy in the observations is due to systematics, or indeed constitutes a major problem for the Standard model.

2.3.2. Origin of Cosmic Background Radiation

According to BBM, about 380,000 years after BB the temperature of the universe fell to the point where nuclei could combine with electrons to create neutral atoms. As a result, photons no longer interacted frequently with matter, the universe became transparent, and Microwave Background Radiation (MBR) was created. This cosmic event is usually referred to as Decoupling. The photons that existed at the time of photon decoupling have been propagating ever since, though growing fainter and less energetic, since the expansion of space causes their wavelength to increase over time. The photons present at the time of decoupling are the same photons that we see in MBR now. But then, **why is MBR is perfect black-body**?

According to **WUM**, wavelength is a classical notion. Photons, which are quantum objects, have only four-momenta. They do not have wavelengths. By definition, "*Black-body radiation is the thermal electromagnetic radiation within or surrounding a body in thermodynamic equilibrium with its environment*". In frames of WUM, the black-body spectrum of MBR is due to thermodynamic equilibrium of photons with the Intergalactic Plasma (IGP), the existence of which is experimentally proved.

2.3.3. Nucleosynthesis of Light Elements

Big Bang Nucleosynthesis (BBN) refers to the production of nuclei other than those of hydrogen during the early phases of the Universe. Primordial nucleosynthesis is believed to have taken place in the interval from roughly 10 seconds to 20 minutes after the BB and is calculated to be responsible for the formation of most of the universe's helium as the isotope helium-4, along with small amounts of deuterium, helium-3, and a very small amount of lithium-7. Essentially all of the elements that are heavier than lithium were created much later, by stellar nucleosynthesis in evolving and exploding stars.

The history of BBN began with the calculations of R. Alpher in the 1940s. During the 1970s, there were major efforts to find processes that could produce deuterium. The problem was that while the concentration of deuterium in the universe is consistent with the BBM as a whole, it is too high to be consistent with a model that presumes that most of the universe is composed of protons and neutrons. The standard explanation now used for the abundance of deuterium is that the universe does not consist mostly of baryons, but that **non-baryonic dark matter** makes up most of the mass of the universe.

According to modern cosmological theory, lithium was one of the three elements synthesized in BB. But in case of lithium, we observe a **cosmological lithium discrepancy** in the universe: older stars seem to have less lithium than they should, and some younger stars have much more. M. Anders, *et al.* report on the results of the first measurement of the $^{2}H(\alpha,\gamma)^{6}Li$ cross section at BB energies. They results have firmly **ruled out BBN lithium production** as a possible explanation for the reported ^{6}Li detections.
In frames of **WUM**, Nucleosynthesis of all elements (including light elements) occurs inside of DM Cores of all Macroobjects (MOs) during their evolution. The theory of Stellar Nucleosynthesis is well developed, starting with the publication of a celebrated $B^{2}FH$ review paper. With respect to WUM, this theory should be expanded to include self-annihilation of heavy DM fermions in MO Cores.

2.3.4. Formation of Galaxies and Large-Scale Structures

The formation and evolution of galaxies can be explained only in terms of gravitation within an inflation + dark matter + dark energy scenario. The standard Hot BBM provides a framework for understanding galaxy formation. At about 10,000 years after BB, the temperature had fallen to such an extent that the energy density of the universe began to be dominated by massive particles, rather than the light and other radiation which had predominated earlier. This change in the form of the main matter density meant that the gravitational forces between the massive particles could begin to take effect, so that any small perturbations in their density would grow.
This brings into focus one of shortcomings of SC – a **density fluctuation problem**: *The perturbations which gravitationally collapsed to form galaxies must have been primordial in origin; from whence did they arise?*
As a conclusion: BBM relies on the following assumptions:

- Homogeneity and isotropy of space;
- Laws of physics are invariant in all inertial systems;
- The speed of light in a vacuum is the same for all observers;
- Massless photons;
- The existence of Cold Dark Matter is a principal point of BBM;
- BBM is inconsistent with the Law of conservation of angular momentum (see Section 2.4).

The performed analysis shows that the Four Pillars of SC are model-dependent and not strong enough to support BBM.

2.4. Angular Momentum Problem [13] [18] [20]

Angular momentum problem is one of the most critical problems in BBM that must be solved. Any theory of evolution of the Universe that is not consistent with the Law of Conservation of Angular Momentum should be promptly ruled out. SC cannot answer the following questions:

- Sun accounts for ~ 0.3% of the total angular momentum of SS while about 60% is attributed to Jupiter;
- SS has an orbital angular momentum that far exceeds rotational angular momentum;
- MW galaxy is gravitationally bounded with Virgo Supercluster and has an orbital momentum, which far exceeds the rotational angular momentum;
- How did MW galaxy and SS obtain their substantial orbital angular momenta?

To the best of our knowledge, the Standard Model does not answer these questions. **WUM is the only cosmological model in existence that is consistent with this Fundamental Law** (see Section 5.2).

2.5. Black Holes [1][16] [23][28]

BH is a **mathematical solution** of Einstein's field equations for gravity in 3+1 dimensional spacetime. The simplest BH solution is the Schwarzschild solution, which describes the gravitational field in the **spherically**

symmetric, static, vacuum case. This solution is characterized with a single parameter, which corresponds to the mass of an object that produces the same gravitational field.

The existence of supermassive compact objects in galactic centers is now commonly accepted. It is commonly believed that the central mass is a Supermassive Black Hole (SBH). There exists, however, evidence to the contrary. In 2013, N. Hurley-Walker spotted a previously unknown radio galaxy NGC1534 that is quite close to Earth but is much fainter than it should be if the central BH was accelerating the electrons in the jets: *"The discovery is also intriguing because at some point in its history the central black hole switched off, but the radio jets have persisted. The interesting thing about the object I found is that it's being hosted by a spiral galaxy, like our own"*. It's also possible there was never a BH there at all.

In 2014, L. Mersini-Houghton claimed to demonstrate mathematically that, given certain assumptions about BH firewalls, current theories of BH formation are flawed. She claimed that Hawking radiation causes the star to shed mass at a rate such that it no longer has the density sufficient to create a BH.

In 2022, the Event Horizon Telescope (EHT) Collaboration presented outstanding 1.3 mm measurements of the radio source located at the position of the supermassive black object Sgr A* . Contemporaneous multiwavelength monitoring of Sgr A* was performed at 22, 43, and 86 GHz and at near-infrared and X-ray wavelengths. Using EHT, astronomers released the first image of the accretion disk around the Sgr A*. Based on the obtained results the EHT Collaboration claimed that Sgr A* is a SBH.

In our opinion, the results obtained by Collaboration are model-dependent and not sufficient to support this claim. Astronomers should answer some principal questions:

- The age of MW is similar to the Age of the World. The oldest star in MW (named Methuselah) is nearly as old as the World itself. If Sgr A* is a SBH, then how it could grow so quickly?
- What is the origin of the alleged SBH positive spin?
- Their models in the "best-bet region" have low inclination 30° and 10° that contradicts the disk shape of the MW galaxy and bipolar astrophysical jets, which are astronomical phenomena where outflows of matter are emitted as the extended beams along the axis of rotation;
- The MW galaxy (including Sgr A*) is gravitationally bounded with VS and has a huge orbital angular momentum (see Section 2.4). How did MW galaxy obtain this substantial orbital angular momentum?
- What is the mechanism of gamma rays emission from the Galactic Center?

In frames of **WUM,** the results obtained by the EHT Collaboration can be explained in the following way:

- The image is dominated by the bright, thick ring with the radius of $3.17 \times 10^{10}\ m$. The ring has a comparatively dim Interior that is made up of DM Fermions DMF1 (1.3 TeV) and DMF2 (9.6 GeV), which are responsible for the excess of gamma-ray emission from Sgr A*;
- Dark Matter Particles (DMPs) are continuously absorbing by the Interior of Sgr A* . Ordinary Matter is a byproduct of DMPs self-annihilation. It is re-emitted by the Interior continuously into a Shell around it;
- Very powerful gamma quants with energy of at least 1.02 MeV in the vicinity of atomic nuclei of the Shell produce electron-positron pairs with high concentration;
- The bright, thick area consists of Ordinary Matter and Electron-Positron plasma with the radius of $2.9 \times 10^{10}\ m$ that is a compact **nonthermal radio object** responsible for the strongest radio emission;
- The area from the radius of $3.17 \times 10^{10}\ m$ to $1.88 \times 10^{12}\ m$ is filled out with DM Fermions DMF3 (3.7 keV), which are responsible for X-rays from the center of MW due to their self-annihilation;
- The enclosed mass of Supermassive Compact Object of $4.154 \times 10^{6}\ M_{\odot}$ is the mass of the MW DM Core made up of DMF1 and DMF2 with the Ordinary Matter and Electron-Positron Shell and DMF3 Shell;
- Sgr A* has gotten the rotational and orbital angular momenta as the result of the rotational fission of the DM Core of the Virgo supercluster;

- The inclination angle between the line of sight and the rotational angular momentum vector of Sgr A* is about 90°.

As a conclusion: The totality of all obtained experimental results testify in favor of the existence of the supermassive compact object made up of Dark Matter particles at MW Center.

Part III. Principal Experimental Results

3.1. Electrodynamic constant

In 1857, W. Weber and R. Kohlrausch determined that there was a quantity related to electricity and magnetism, "*the ratio of the absolute electrostatic unit of charge to the absolute electromagnetic unit of charge*" (in modern language, the **electrodynamic constant** $\boldsymbol{c}$ **with the value** $\boldsymbol{c = 1/\sqrt{\mu_0 \varepsilon_0}}$, where μ_0 is the permeability of free space and ε_0 is the permittivity of free space) and determined that it should have units of velocity. They measured this ratio by an experiment which involved charging and discharging a **Leyden jar** and measuring the magnetic force from the discharge current and found a value of $c = 3.107 \times 10^8\ m/s$, remarkably close to the speed of light, which had recently been measured at $c_{light} = 3.15 \times 10^8\ m/s$ by H. Fizeau in 1849 and at $c_{light} = 2.98 \times 10^8\ m/s$ by L. Foucault in 1850. However, Weber and Kohlrausch did not make the connection to the speed of light. In 1861, J. Maxwell established the connection to the speed of light and concluded that light is a form of electromagnetic radiation.

In the physical sciences, the **wavenumber** k is the **spatial frequency** of a wave. Whereas **temporal frequency** can be thought of as the number of waves per unit time, wavenumber is the number of waves per unit distance. The wavenumber follows from the Helmholtz wave equation, which can be derived from Maxwell's equations (MEs). The Helmholtz equation is a partial differential equation:

$$\nabla^2 E - \omega^2 \mu\varepsilon E = 0$$

For a plane wave of angular frequency ω traveling in the x direction, the solution to the Helmholtz equation is of the form:

$$E(x,t) = E_0 \cos(\omega t - kx)$$

where k is the wavenumber, which is given by:

$$k = \omega\sqrt{\mu\varepsilon}$$

Electromagnetic waves in any bulk material move at the velocity of light v_{light} that is a function of permeability μ and permittivity ε of the material:

$$v_{light} = 1/\sqrt{\mu\varepsilon}$$

In free space, electromagnetic waves move at the velocity c_{light}:

$$c_{light} = 1/\sqrt{\mu_0 \varepsilon_0} = c$$

The free-space k_0 can be expressed as a function of frequency f and velocity, or just the wavelength:

$$k_0 = \frac{\omega}{c_{light}} = \frac{2\pi f}{c} = \frac{2\pi}{\lambda}$$

From this equation, we can get a relation $\boldsymbol{c = f\lambda}$, where c is the **electrodynamic constant** (see Section 3.2).

3.2. Speed of Light [Wikipedia]

The first measurement of the speed of light v_{light} was made by H. Fizeau in 1849: $v_{light} = 315000\ km/s$ with +5.1% error. The last measurement of v_{light} with rotating mirror was made by A. Michelson in 1926: $v_{light} = 299796 \pm 4\ km/s$ with +12 ppm error.

Another way to find v_{light} is to independently measure the frequency f and wavelength λ of an electromagnetic wave and calculate it using the relation $\boldsymbol{v_{light} = f\lambda}$. One option is to measure the resonance frequency of a cavity resonator. If the dimensions of the resonance cavity are also known, these can be used to determine the wavelength of the wave. In 1950, L. Essen obtained the following result: $v_{light} = 299792.5 \pm 4\ km/s$ with +0.14 ppm error.

Interferometry is another method to find wavelength of electromagnetic radiation for determining v_{light} . A coherent beam of light (e.g. from a laser), with a known frequency f , is split to follow two paths and then recombined. By adjusting the path length while observing the interference pattern and carefully measuring the change in path length, the wavelength of the light λ can be determined. v_{light} is then calculated using the equation $\boldsymbol{v_{light} = f\lambda}$. In 1972, using the laser interferometer method a group at the US National Bureau of Standards in Boulder, Colorado determined the speed of light to be $v_{light} = 299792456.2 \pm 1.1\, m/s$. This was 100 times less uncertain than the previously accepted value.

In 1983, the 17th meeting of the General Conference on Weights and Measures (CGPM) redefined the metre as: "The metre is the length of the path traveled by light (**in vacuum ?**) during a time interval of 1/299792458 of a second". As a result of this definition, the value of the speed of light **(in vacuum ?**) is exactly 299792458 m/s and has become a defined constant in the SI system of units.

In **WUM**, there are no speed of light in vacuum and massless photons because there is no vacuum in the World. In reality, there is the Medium of the World with IGP and the minimum energy of photons passing through IGP (see Section 5.3.4). We emphasize that c is the **electrodynamic constant** in MEs but not a speed of light in vacuum as it is accepted now. Using the relation $\boldsymbol{v_{light} = f\lambda}$ is, in fact, the way to measure the value of the electrodynamic constant (see Section 3.1).

3.3. Cosmic Microwave Background

In 1965, A. Penzias and R. Wilson discovered Cosmic Microwave Background Radiation (MBR).

3.4. Fast Radio Bursts [7] [8]

In radio astronomy, a Fast Radio Burst (FRB) is a transient radio pulse of length ranging from a fraction of a millisecond to a few milliseconds, caused by some high-energy astrophysical process not yet understood. Astronomers estimate the average FRB releases as much energy in a millisecond as the Sun puts out in 3 days. The first FRB was discovered by D. Lorimer and D. Narkevic in 2007. FRBs have pulse dispersion measurements $> 100\, pc\, cm^{-3}$, much larger than expected for a source inside the MW galaxy and consistent with a propagation through IGP.

The existence of MBR and IGP means that there is no vacuum in the universe as it was claimed by SR in 1905. In **WUM**, we introduce the Medium of the World, which is composed of stable elementary particles: protons, electrons, photons, neutrinos, and DMPs.

Part IV. Hypotheses Revisited by WUM

4.1. Aether [12]

Physical Aether was suggested as early as 18th century, by I. Newton. Following the work of T. Young (1804) and A-J. Fresnel (1816), it was believed that light propagates as a transverse wave within an elastic medium called Luminiferous Aether. At that time, it was realized that Aether could not be an elastic matter of an ordinary type that can only transmit longitudinal waves.

Unique properties of Aether were discussed by J, McCullagh in 1846 who proposed a theory of a rotationally elastic medium. The potential energy of deformation in such a medium depends only on the rotation of the volume elements and not on their compression or general distortion. This theory produces equations analogous to Maxwell's equations. Aether with these properties can transmit transverse waves. J. McCullagh has this to say about the Aether: "*The constitution of the aether, if it ever would be discovered, will be found to be quite different from anything that we are in the habit of conceiving, though at the same time very simple and very beautiful. An elastic medium composed of points acting on each other in the way supposed by Poisson and others will not answer*."

Luminiferous Aether was abandoned in 1905 by Special Relativity. In later years there have been classical physicists who advocated the existence of Aether:

- N. Tesla declared in 1937 in "Prepared Statement on the 81st birthday observance": *All attempts to explain the workings of the universe without recognizing the existence of the aether and the indispensable function it plays in the phenomena are futile and destined to oblivion* ;
- P. Dirac stated in 1951 in an article in Nature, titled "Is there an Aether?" that *we are rather forced to have an aether* .

WUM is based on Maxwell's equations, and McCullagh's theory is a good fit for description of the Medium. The Model introduces the Medium of the World that is some kind of "Aether" composed of stable elementary particles. The existence of the Medium is a principal point of WUM. It follows from the observations of IGP; MBR; Far-Infrared Background (FIFB) Radiation. According to WUM, inter-galactic voids discussed by astronomers are, in fact, examples of the Medium in its purest. The Medium is the absolute frame of reference. The total energy density of the Medium is 2/3 of the total energy density of the World in all cosmological times. All Macroobjects (MOs) are built from the same particles. The energy density of MOs adds up to 1/3 of the total energy density throughout the World's evolution. In our opinion, the **Medium of the World is the Savior of Classical Physics! Don't throw the baby out with the bathwater.**

4.2. Le Sage's Theory of Gravitation [12] [25]

Wikipedia summarizes this unique theory as follows: *"Sage's theory of gravitation is a kinetic theory of gravity originally proposed by Nicolas Fatio de Duillier in 1690 and later by Georges-Louis Le Sage in 1748. The theory proposed a mechanical explanation for Newton's gravitational force in terms of streams of tiny unseen particles (which Le Sage called ultra-mundane corpuscles) impacting all material objects from all directions. According to this model, any two material bodies partially shield each other from the impinging corpuscles, resulting in a net imbalance in the pressure exerted by the impact of corpuscles on the bodies, tending to drive the bodies together".*

Le Sage proposed quantitative estimates for some of the theory's parameters:

- He called the gravitational particles ultramundane corpuscles because he supposed them to originate beyond our known universe. The distribution of the ultramundane flux is isotropic, and the laws of its propagation are very similar to that of light;
- He suggested that the ultramundane corpuscles might move at the speed of light;
- To maintain mass proportionality, ordinary matter consists of cage-like structures, in which their diameter is only the 10^7th part of their mutual distance, so the particles can travel through them nearly unhindered.

L. Spitzer in 1941 calculated, that absorption of radiation between two dusts particles lead to a net

attractive force which varies proportional to r^{-2}. The Le Sage mechanism also has been identified as a significant factor in the behavior of dusty plasma. A. M. Ignatov has shown that an attractive force arises between two dust grains suspended in isotropic collisionless plasma due to inelastic collisions between ions of the plasma and the grains of dust. This attractive force is inversely proportional to the square of the distance between dust grains and can counterbalance the Coulomb repulsion between dust grains.

In frames of **WUM**, the time-varying Gravitational parameter $G \propto \tau^{-1}$ is proportional to the energy density of the Medium of the Word $\rho_M \propto \tau^{-1}$ (see Section 5.3.1). It is not constant. That is why, WUM aligns gravity with the Le Sage's theory of gravitation. In WUM, the gravity is a result of simple interactions of DM particles DMF4 with Matter that work cooperatively to create a more complex interaction. The total DMF4 energy density is about 68.8% of the total energy density of the World (see Section 5.3.8). DM particles DMF4 are responsible for the Le Sage's mechanism of the gravitation.

To summarize:

- Le Sage's theory of gravitation defines Gravity as an emergent phenomenon;
- Gravity is not an interaction but a manifestation of the Medium;
- The proposed mechanism of Gravitation resembles Le Sage's theory.

4.3. Hypersphere Universe [7]

In 1854, G. Riemann proposed a Hypersphere as a model of a finite universe. A hypersphere is the four-dimensional analog of a sphere. A regular three-dimensional Ball has a two-dimensional surface. Similarly, a 4-dimensional Ball (the Nucleus of the World) has a 3-dimensional surface (the Hypersphere).

In 1870, W. Clifford made the statement that matter is nothing, but ripples, hills and bumps of space curved in a higher dimension and the motion of matter is nothing more than variations in that curvature. He speculated that the force of electricity and magnetism is caused by the bending of higher-dimensional space and planned to add gravity to his theory at later date. This is the first time that anyone had speculated that a "force" is nothing but the bending of space itself, preceding A. Einstein by 45 years. Clifford's idea that electromagnetism was caused by vibrations in the fourth dimension also preceded the work of T. Kaluza, who would also attempt to explain electromagnetism with the higher dimension.

WUM follows the idea of the Hypersphere Universe, albeit proposing that the World is evenly stretched as the result of the expansion of the Nucleus of the World along the fourth spatial dimension. The World is filled out with the Medium and MOs consisting of stable elementary particles.

4.4. Gravitoelectromagnetism [11] [28]

Gravitoelectromagnetism (GEM) is a gravitational analog of Electromagnetism. GEM equations differing from Maxwell's equations by some constants were first published by O. Heaviside in 1893 as a separate theory expanding Newton's law. GEM is an approximation to the Einstein's gravity equations in the weak field limit. H. Thirring pointed out this analogy in his "*On the formal analogy between the basic electromagnetic equations and Einstein's gravity equations in first approximation*" paper published in 1918. It allows us to use formal analogies between the electromagnetism and relativistic gravity. In case of the strong field limit, we should use the Einstein's gravity equations.

In 2021, G. Ludwig in his paper "Galactic rotation curve and dark matter according to gravitomagnetism" wrote: *Most theories used to explain the rotation curve have been restricted to the Newtonian potential*

framework, disregarding the general relativistic corrections associated with mass currents. In this paper it is shown that the gravitomagnetic field produced by the currents modifies the galactic rotation curve, notably at large distances. The coupling between the Newtonian potential and the gravitomagnetic flux function results in a nonlinear differential equation that relates the rotation velocity to the mass density. The solution of this equation reproduces the galactic rotation curve without recourse to obscure dark matter components. ***The effects attributed to dark matter can be simply explained by the gravitomagnetic field produced by the mass currents*** [Ludwig, G. O. (2021) Galactic rotation curve and dark matter according to gravitomagnetism. Eur. Phys. J. C **81**, Article number:186. https://doi.org/10.1140/epjc/s10052-021-08967-3].

In accordance with **WUM**, DM is concentrated in the Cores of all MOs. There are no BHs. Instead, there are DM Cores of galaxies. WUM is based on the Gravitomagnetism. The explanation of galactic rotation curve made by G. O. Ludwig is in good agreement with the approach of WUM.

4.5. Dirac Large Number Hypothesis [12]

Dirac Large Number Hypothesis is an observation made by P. Dirac in 1937 relating ratios of size scales in the Universe to that of force scales. The ratios constitute very large, dimensionless numbers, some 40 orders of magnitude in the present cosmological epoch. According to Dirac's hypothesis, the apparent equivalence of these ratios might not to be a mere coincidence but instead could imply a cosmology where the strength of gravity, as represented by the gravitational "constant" G, is inversely proportional to the cosmological time τ: $G \propto \tau^{-1}$.

WUM follows the idea of time-varying G and introduces a dimensionless time-varying quantity Q, which is a measure of the Size R and Age A_τ of the World and is, in fact, Dirac Large Number:

$$Q = \frac{R}{a} = \frac{A_\tau}{t_0}$$

where $t_0 = a/c$ is the basic time unit. In the present Epoch, $Q = 0.759972 \times 10^{40}$.

4.6. Emergent Gravity, Space and Time [12]

C. Barcelo, *et al.* have this to say about emergent gravity: *One of the more fascinating approaches to "quantum gravity" is the suggestion, typically attributed to Sakharov that gravity itself may not be "fundamental physics". Indeed, it is now a relatively common opinion, that gravity (and in particular the whole notion of spacetime and spacetime geometry) might be no more "fundamental" than is fluid dynamics. The word "fundamental" is here used in a rather technical sense – fluid mechanics is not fundamental because there is a known underlying microphysics that of molecular dynamics, of which fluid mechanics is only the low-energy low-momentum limit*.

WUM: Time and Space are closely connected with Mediums' Impedance and Gravitomagnetic parameter. It follows that neither Time nor Space could be discussed in absence of the Medium. The gravitational parameter G that is proportional to the Mediums' energy density can be introduced only for the Medium filled with Matter. Gravity, Space and Time are all emergent phenomena. In this regard, it is worth to recall the Einstein's quote: *When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter.*

Part V. Hypersphere World-Universe Model

5.1. Assumptions [27]

WUM is based on the following primary assumptions:

- The World is a Finite Boundless 3D Hypersphere of a 4D Nucleus of the World that is expanding along the fourth spatial dimension of the Nucleus with speed equals to the gravitodynamic constant c. As the result, the Hypersphere is evenly stretched;
- The Eternal Universe serves as an unlimited source of DM, which is continuously created in the Nucleus of the World. Ordinary Matter is a byproduct of DMPs self-annihilation;
- The Medium of the World, consisting of protons, electrons, photons, neutrinos, and DMPs, is an active agent in all physical phenomena in the World;
- Two fundamental parameters in various rational exponents define all macro and micro features of the World: dimensionless Rydberg constant α and dimensionless quantity Q that is a measure of the Size R and Age A_τ of the World and is, in fact, the Dirac Large Number.

5.2. Principal Points [9] [10] [19] [21] [22] [27]

WUM is based on the following Principal Points:

The Beginning. The World was started by a Fluctuation in the Eternal Universe, and the Nucleus of the World, which is a 4D ball, was born. An extrapolated Nucleus radius at the Beginning was equal to the basic size unit of a. The extrapolated energy density of the World at the Beginning was four orders of magnitude smaller than the nuclear energy density. The World is a Finite Boundless 3D Hypersphere that is the surface of the 4D Nucleus. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World. The **Initial Center of the World** coincides with the center of the 4D Nucleus and located in the fourth spatial dimension of the Nucleus. **The 3D World is curved in the fourth spatial dimension!**

Expansion. The 4D Nucleus is expanding along Its fourth spatial dimension and Its surface, the 3D Hypersphere, is evenly stretched so that the radius of the Nucleus is increasing with speed c that is the gravitodynamic constant. The stretching of the Hypersphere World can be understood through the analogy with expanding 3D balloon: imagine an ant residing on a seemingly two-dimensional surface of a balloon. As the balloon is blown up, its radius increases, and its surface grows. The distance between any two points on the surface increases. The ant sees her world expands but does not observe a preferred center.

Creation of Matter. The surface of the Nucleus is created in a process analogous to sublimation. Continuous creation of matter is the result of this process. Sublimation is a well-known endothermic process that happens when surfaces are intrinsically more energetically favorable than the bulk of a material, and hence there is a driving force for surfaces to be created. DM is created by the Universe in the 4D Nucleus of the World. DMPs carry new DM into the 3D Hypersphere World. Ordinary Matter is a byproduct of DMPs self-annihilation. Consequently, a Matter-Antimatter Asymmetry problem discussed in literature does not arise (since antimatter does not get created by DMPs self-annihilation). By analogy with 3D ball, which has 2D spherical surface (that has surface energy), we can imagine that the 3D Hypersphere World has a "Surface Energy" of the 4D Nucleus. The grows of the surface of the 4D Nucleus means the increase of the World's "Surface Energy".

The proposed 4D process is responsible for the Expansion, Creation of Matter, and Arrow of Time. It constitutes the main **Hypothesis of WUM**. In our view, the arrow of the Cosmological Time does not depend on any physical phenomenon in the Medium of the World. It is the result of the Worlds' expansion due to the driving force for surfaces to be created. It is important to emphasize that:

- Creation of Matter is a direct consequence of expansion;
- Creation of DM occurs homogeneously in all points of the 3D Finite Boundless Hypersphere World.

Content of the World. The World consists of the Medium and MOs. Total energy density of the World equals to the critical energy density throughout the World's evolution. The energy density of the Medium is 2/3 of the total energy density and MOs (Superclusters, Galaxies, Extrasolar Systems (ESS), Planets, Moons, *etc*.) – 1/3 in all cosmological times. The relative energy density of DM particles DMF4 is about 68.8%, self-annihilating DMPs (DMF1, DMF2, DMF3, DIRACs, and ELOPs) – about 24%, and Ordinary particles (protons, electrons, photons, and neutrinos) – about 4.8% in the Medium of the World and 2.4% in MOs (see Section 5.3.8).

Two Fundamental Parameters in various rational exponents define all micro- and macro-features of the World: dimensionless Rydberg constant α and Quantity Q. The World's energy density is proportional to Q^{-1} in all cosmological times. Particles relative energy densities are proportional to α.

We do not know that our 3D space is curved. But we know that it is expanding without center of expansion. We introduce the radius of the curvature in the fourth spatial dimension $R = a \times Q$ to give an explanation providing insight into the curved nature of the World. In WUM, Local Physics is linked with the large-scale structure of the Hypersphere World through the dimensionless quantity Q. The proposed approach to the fourth spatial dimension agrees with Mach's principle: "*Local physical laws are determined by the large-scale structure of the universe* ". Applied to WUM, it follows that all parameters of the World depending on Q are a manifestation of the Worlds' curvature in the fourth spatial dimension.

Supremacy of Matter. Time, Space and Gravitation have no separate existence from Matter. They are closely connected with the Impedance, Gravitomagnetic parameter, and Energy density of the Medium, respectively.

WUM reveals the **Inter-Connectivity of Primary Cosmological Parameters** (PCPs) and calculates their values, which are in good agreement with the latest results of their measurements.

The mechanism that can provide Angular Momenta to Macroobjects is **Rotational Fission** of overspinning (surface speed at equator exceeding escape velocity) Prime Objects. From the point of view of Fission model, the prime object is transferring some of its rotational angular momentum to orbital and rotational momenta of satellites. It follows that the rotational momentum of the prime object should exceed the orbital momentum of its satellite. In frames of WUM, prime objects are DM Cores of Superclusters, which must accumulate tremendous rotational angular momenta before the Birth of the Luminous World. It means that it must be some long enough time in the history of the World, which we named "Dark Epoch".

WUM introduces **Dark Epoch** (spanning from the Beginning of the World for 0.45 billion years) and **Luminous Epoch** (ever since, 13.77 billion years). Transition from Dark Epoch to Luminous Epoch is due to an **Explosive Volcanic Rotational Fission** of Overspinning DM Supercluster's Cores and self-annihilation of DMPs.

Macroobjects Shell Model. MOs of the World possess the following properties: their Cores are made up of DMPs; they contain other particles, including DMPs and Ordinary Particles, in shells surrounding the Cores. Introduced **Weak Interaction** between DMPs and Ordinary particles provides integrity of all shells. Self-annihilation of DMPs can give rise to any combination of gamma-ray lines.

Macroobjects Formation. Superclusters are the principal objects of the World. Macroobjects form from the top (Superclusters) down to Galaxies and Extrasolar systems in parallel around different Cores made up of different DMPs. 3D Finite Boundless World presents a Patchwork Quilt of different Luminous Superclusters ($\gtrsim 10^3$), which emerged in different places of the World at different Cosmological times. The distribution of Macroobjects in the World is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous.

Macroobjects Evolution. Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing. Assuming the Eternal Universe, numbers of cosmological structures on all levels will increase; new superclusters will form; existing clusters will obtain new galaxies; new stars will be born inside existing galaxies; sizes of individual stars will increase. The temperature of the Medium will asymptotically approach absolute zero.

Nucleosynthesis of all elements occurs inside of MOs during their evolution.

Solar Corona, Geocorona and Planetary Coronas made up of DMPs resemble honeycombs filled with plasma particles (electrons, protons, and multicharged ions), which are the result of DMPs self-annihilation.

Dark Matter Reactors. MOs' cores are essentially Dark Matter Reactors fueled by DMPs. All chemical elements, compositions, radiations are produced by MOs themselves as the result of DMPs self-annihilation in their DM cores.

As a conclusion: The described picture of the creation and evolution of the World is, in fact, a Paradigm Shift for Cosmology.

5.3. Predictions and Explained Problems [1]-[7] [14] [17] [23] [28]

> *It doesn't make any difference how beautiful your guess is, it doesn't make any difference how smart you are, who made the guess, or what his name is. If it disagrees with experiment, it is wrong. That is all there is to it.*
>
> Richard Feynman

In 2013, WUM revealed a self-consistent set of time-varying values of PCPs of the World: Gravitation parameter, Hubble's parameter, Temperature of MBR, and concentration of IGP. Based on the inter-connectivity of these parameters WUM performed precise calculations of PCPs values that were only measured experimentally earlier and made verifiable predictions. The remarkable agreement of the calculated values of PCPs with the observational data gives us considerable confidence in the Model.

5.3.1. Newtonian Constant of Gravitation

The very first manuscript "World-Universe Model" (WUM) was uploaded on viXra in March 2013. At that time great results in Cosmology were achieved:

- The cosmic FIRB was announced in 1999 ;
- MBR temperature was measured in 2009 ;
- Nine-Year Wilkinson Microwave Anisotropy Probe Observations were published in 2012 .

At the same time, the most important for the Cosmology, Newtonian constant of gravitation G, proved too difficult to measure. Its measurement precision was the worst among all Fundamental physical constants.

In 2010, CODATA stated the following value of G:

$$G(2010) = 6.67384 \times 10^{-11} m^3 kg^{-1} s^{-2} \ (120\ ppm)$$

with Relative Standard Uncertainty (RSU): $RSU = 1.2 \times 10^{-4} = 120\ ppm$.

In 2013, WUM proposed a principally different way to solve the problem of G measurement precision. WUM revealed a self-consistent set of time-varying values of PCPs. Based on the value of Fermi Coupling constant in 2010:

$$G_F(2010) = 1.166364 \times 10^{-5} GeV^{-2} \ (4.3\ ppm)$$

WUM predicted the value of the gravitational constant G^*_{2014} equals to:

$$G^*_{2014} = \ 6.67420 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

and recommended this value to CODATA. To the best of our knowledge, no breakthrough in G measurement methodology has been achieved since. Nevertheless, in 2015 CODATA recommended a more precise value of G(2014):

$$G(2014) = 6.67408 \times 10^{-11} m^3 kg^{-1} s^{-2} \ (47\ ppm)$$

In 2018, the recommendation improved further:

$$G(2018) = 6.67430 \times 10^{-11} m^3 kg^{-1} s^{-2} \ (22\ ppm)$$

Since 2013, the relative standard uncertainty of G measurements reduced from 120 ppm to 22 ppm! It seems that CODATA considered the WUM's recommendation of the predicted value of G and used it for G(2014) and $G(2018)$ without any reference or explanation of their methodology.

Considering a more precise value of Fermi Coupling constant in 2014:

$$G_F(2014) = 1.1663787 \times 10^{-5} GeV^{-2} \ (0.51\ ppm)$$

WUM calculated the predicted value of gravitational constant G^*_{2018} :

$$G^*_{2018} = \ 6.674536 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

which is x8 more accurate than G^*_{2014} . The predicted value of G^*_{2018} is in excellent agreement with the experimentally measured by Q. Li, *et al.* in 2018 values of G using two independent methods:

$$G(1) = 6.674184 \times 10^{-11} m^3 kg^{-1} s^{-2} \ (11.64\ ppm)$$

$$G(2) = 6.67484 \times 10^{-11} m^3 kg^{-1} s^{-2} \ (11.61\ ppm)$$

WUM recommend for consideration in CODATA Recommended Values of the Fundamental Physical Constants 2022 the predicted value of the Newtonian Constant of Gravitation G^*_{2018} .

5.3.2. Hubble's Constant

The results of measurements of the Hubble's constant H_0 , which characterizes the expansion rate of the universe, shows that the values of H_0 vary significantly depending on Methodology. The disagreement in the values of H_0 obtained by the various teams far exceeds the standard uncertainties provided with the values. This discrepancy is called the **Hubble Tension**.

In frames of **WUM**, the Hubble tension can be explained the following way:

- All measurements of H are model-dependent;

- Statistics of these measurements is not sufficient to yield reliable conclusions;
- Hubble's law in SC is valid for BBM only when all galaxies start their movement from a single point named "Initial Singularity" that is not the case in WUM;
- There are observations of Galaxies, which belong to different Superclusters.

According to WUM, the value of H depends on the cosmological time: $H = \tau^{-1}$. It means that the **value of H should be measured based on Cosmic Microwave Background Radiation only.** The calculated value of Hubble's constant in 2013: $H_0 = 68.733\ km/s\ Mpc$ is in excellent agreement with the most recent measured value in 2021: $H_0 = 68.7 \pm 1.3\ km/s\ Mpc$ using only MBR data.

The main differences between BBM and WUM are:

- Mainstream scientists, following BBM, measure the values of H based on various characteristics of MOs, the distribution of which in the World is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous;
- WUM suggests that the value of H should be measured based on MBR only, which depends on the characteristics of the Medium of the World. The Medium is Homogeneous and Isotropic. Its parameters do not practically depend on MOs, which can create some disturbances in It.

This explanation is in good agreement with the experimental results provided by W. L. Freedman who belongs to the camp that believes that the difference could be due to errors in measurement. **I belong to the camp that believes that the difference is significant!**

5.3.3. Missing Baryon

The Missing Baryon Problem is related to the fact that the observed amount of baryonic matter did not match theoretical predictions. Observations by the Planck spacecraft in 2015 yielded a theoretical value for baryonic matter of 4.85% of the contents of the Universe. However, directly adding up all the known baryonic matter produces a baryonic density less than half of this.

The existence of the Medium of the World is a principal point of WUM. It follows from the observations of MBR and IGP. Detailed analysis of IGP carried out in 2013 showed that the relative energy density of protons in the Medium Ω_p is: $\Omega_p = 2\pi^2\,\alpha/3 = 4.8014655\%$.

In our opinion, direct measurements of the IGP parameters can be done by investigations of Fast Radio Bursts, which are millisecond duration radio signals originating from distant galaxies. These signals are dispersed according to a precise physical law and this dispersion is a key observable quantity which, in tandem with a redshift measurement, can be used for fundamental physical investigations.

The dispersion measure and redshift, carried out in 2016 by E. F. Keane, *et al.*, provide a direct measurement of density of ionized baryons in the intergalactic medium Ω_{IGM}: $\Omega_{IGM} = 4.9 \pm 1.3\%$ that is in excellent agreement with the predicted by WUM value of Ω_p in 2013.

5.3.4. Minimum Energy of Photons

Analysis of IGP shows that the value of the lowest plasma frequency ν_{pl} is:

$$\nu_{pl} = (m_e/m_p)^{1/2} t_0^{-1} \times Q^{-1/2} = 4.5322\ Hz$$

Photons with energy smaller than $E_{ph} = h\nu_{pl}$ cannot propagate in plasma, thus $h\nu_{pl}$ is the smallest amount of energy a photon may possess. Following L. Bonetti, *et al.* we can call this amount of energy the rest energy of photons that equals to

$$E_{ph} = (m_e/m_p)^{1/2} E_0 \times Q^{-1/2} = 1.8743 \times 10^{-14}\ eV$$

The above value, predicted by WUM in 2013, is in good agreement with the value

$$E_{ph} \lesssim\ 2.2 \times 10^{-14}\ eV$$

obtained by L. Bonetti, *et al.* in 2017. It is more relevant to call E_{ph} the minimum energy of photons which can pass through IGP.

5.3.5. Black-body spectrum of MBR

According to BBM, the photons that existed at the time of photon decoupling have been propagating ever since, though growing fainter and less energetic, since the expansion of space causes their wavelength to increase over time. The photons present at the time of decoupling are the same photons that we see in MBR now. But then, **why MBR is a perfect black-body**?

According to **WUM**, wavelength is a classical notion. Photons, which are quantum objects, have only four-momenta. They don't have wavelengths. By definition, "*Black-body radiation is the thermal electromagnetic radiation within or surrounding a body in thermodynamic equilibrium with its environment*". In frames of WUM, the black-body spectrum of MBR is due to thermodynamic equilibrium of photons with IGP. We calculate the value of MBR temperature T_{MBR}:

$$T_{MBR} = \frac{E_0}{k_B}\left(\frac{15\alpha}{2\pi^3}\frac{m_e}{m_p}\right)^{1/4} \times Q^{-1/4} = 2.72518\ K$$

The calculated value of T_{MBR} is in excellent agreement with measured value of $2.72548 \pm 0.00057\ K$.

5.3.6. Far-Infrared Background Radiation

The cosmic FIRB which was announced in 1998, is part of the Cosmic Infrared Background with wavelengths near 100 microns that is the peak power wavelength of the black-body radiation at temperature 29 K. In frames of WUM, we calculate the temperature of the peak of FIRB T_{FIRB}:

$$T_{FIRB} = \left(15/4\pi^5\right)^{1/4} E_0/k_B \times Q^{-1/4} = 28.955\ K$$

that is in an excellent agreement with experimentally measured value of $29\ K$.

5.3.7. Center of Milky Way Galaxy

In 2013, WUM made one of the most important predictions: "*Macroobjects of the World have cores made up of the discussed DM (Dark Matter) particles. Other particles, including DM and baryonic matter, form shells surrounding the cores*". Prof. R. Genzel and A. Ghez confirmed this prediction: "The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy" (Nobel Prize in Physics 2020). On May 12, 2022, astronomers, using the Event Horizon Telescope, released the first image of the accretion disk around the Sagittarius A*(Sgr A*) produced using a world-wide network of radio observatories made in April 2017. They claimed that Sgr A* is SBH. We analyzed these results. Based on the totality of all accumulated experimental results for the Center of MW we conclude that **Sgr A* is the DM Core of our Galaxy**.

5.3.8. Rest Energies of DMPs and Neutrinos

WUM proposes **multicomponent DM system** consisting of two couples of coannihilating DMPs: a heavy Dark Matter Fermion (DMF) – DMF1 (1.3 TeV) and a light spin-0 boson – DIRAC (70 MeV) that is a dipole of Dirac's monopoles with charge $\mu = e/2\alpha$ (e is the elementary charge); a heavy fermion – DMF2 (9.6 GeV) and a light spin-0 boson – ELOP (340 keV) that is a dipole of preons with electrical charge e/3; self-

annihilating fermions – DMF3 (3.7 keV) and DMF4 (0.2 eV). The reason for this multicomponent DM system was to explain

- The diversity of Very High Energy gamma-ray sources in the World;
- The diversity of DM Cores of Macroobjects of the World (superclusters, galaxies, and extrasolar systems), which are Fermion Compact Objects in WUM.

WUM predicts the following **rest energies for neutrinos**: a tauonic neutrino ($4.5 \times 10^{-2}\ eV$); a muonic neutrino ($7.5 \times 10^{-3}\ eV$); and an electronic neutrino ($3.1 \times 10^{-4}\ eV$).

5.3.9. Distribution of Matter

The relative energy density of DMF4 particles is about 68.8%, self-annihilating DMPs (DMF1, DMF2, DMF3, DIRACs, and ELOPs) – about 24%, and Ordinary Particles (protons, electrons, photons, and neutrinos) – about 4.8% in the Medium of the World and 2.4% in Macroobjects.

5.3.10. Weak Interaction

WUM introduce **Weak Interaction** between DMPs and Ordinary particles that provides integrity of all Shells in MOs' Cores.

5.3.11. Explained Problems

WUM solves a number of physical problems in contemporary Cosmology and Astrophysics through DMPs and their interactions:

- **Angular Momentum problem** in birth and subsequent evolution of Galaxies and ESS explained by the Explosive Volcanic Rotational Fission of Overspinning DM Supercluster's Cores;
- **Hubble Tension** explained by observations of Galaxies, which belong to different Superclusters. The value of H should be measured based on Cosmic Microwave Background Radiation only;
- **Missing Baryon problem,** related to the fact that the observed amount of baryonic matter did not match theoretical predictions, solved by the calculation of the concentration of IGP;
- **Fermi Bubbles** – two large structures in gamma-rays and X-rays above and below Galactic center – are stable clouds of DMPs (DMF1, DMF2, and DMF3) containing uniformly distributed Dark Matter Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays;
- **Galaxies are ellipticals and spirals** due to an Explosive Volcanic Rotational Fission of their Overspinning DM Cores;
- **Coronal Heating Problem** relates to a question of why the temperature of the Solar corona is millions of degrees higher than that of the photosphere. According to WUM, the origin of the Solar corona plasma is not the coronal heating. Plasma particles (electrons, protons, multicharged ions) are so far apart that plasma temperature in the usual sense is not very meaningful. The plasma is the result of a self-annihilation of DMPs. The Solar corona made up of DMPs resembles a honeycomb filled with plasma;
- **Cores of Sun and Earth** rotating faster than their surfaces despite high viscosity of the internal medium. WUM explains the phenomenon through absorption of DMPs by Cores. DMPs supply not only additional mass ($\propto \tau^{3/2}$), but also additional angular momentum ($\propto \tau^{2}$). Cores irradiate products of self-annihilation, which carry away excessive angular momentum. The Solar wind is the result of this mechanism;
- **Diversity of Gravitationally-Rounded Objects** in SS is explained by Dark Matter Reactors inside of MOs fueled by DMPs. All chemical elements, compositions, radiations are produced by MOs themselves as the result of DMPs self-annihilation in their different DM cores;

- **Internal Heating of Gravitationally-Rounded Objects** in SS is explained by Dark Matter Reactors inside of all MOs fueled by DMPs. Internal Heating is due to DMPs self-annihilation;
- **Faint young Sun paradox** describes the apparent contradiction between observations of liquid water early in Earth's history and the astrophysical expectation that the Sun's output would be only 70% as intense during that epoch as it is during the modern epoch. In WUM, all MOs of the World were fainter in the past. As their cores absorb new DMPs, the sizes of MOs and thus their luminosity are increasing in time $\propto \tau$. Considering the age of the World $\cong$ 14.2 Byr and the age of SS $\cong$ 4.6 Byr, it is easy to find that the young Sun's output was only 67.6% of what it is today;
- **Matter-Antimatter Asymmetry problem.** Ordinary Matter is a byproduct of DMPs self-annihilation. This problem does not arise (since antimatter does not get created by DMPs self-annihilation);
- **Black-body spectrum of MBR** is due to thermodynamic equilibrium of photons with IGP;
- **Unidentified Infrared Discrete Emission Bands** with peaks 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm explained by self-annihilation of DM particles DMF4 (0.2 eV);
- **Solar Corona, Geocorona and Planetary Coronas** made up of DMPs resemble honeycombs filled with plasma particles (electrons, protons, multicharged ions), which are the result of DMPs self-annihilation;
- **Lightning Initiation problem** and **Terrestrial Gamma-Ray Flashes** are explained by the self-annihilation of DMPs in Geocorona;
- **Ball Lightnings** are the objects that have cores made up of DMPs surrounded by the electron-positron plasma shells contaminated by chemical elements of soil and air as the result of Terrestrial Gamma-Ray Flash strikes of the ground. WUM predicts a **new phenomenon** – a generation of Ball Lightnings (BLs) according to the proposed model of them. Once we master a creation of BLs in a controlled environment, we can concentrate our efforts on harvesting that energy from a practically infinite Source – the Medium of the World with DMPs.

As a conclusion: Medium of the World, Dark Matter, and Angular Momentum are **Three Pillars of WUM**.

In our view, great experimental results and observations achieved by Astronomy in the last decades should be analyzed through the prism of a New Paradigm based on WUM. Astronomers should plan new purposeful experiments based on the results of these analyses.

Part VI. Classical Physics

6.1. Primary Notions [Wikipedia]

According to Wikipedia, **Classical Physics** *is a group of physics theories that predate modern, more complete, or more widely applicable theories. If a currently accepted theory is considered to be modern, and its introduction represented a major paradigm shift, then the previous theories, or new theories based on the older paradigm, will often be referred to as belonging to the area of "classical physics".*
As such, the definition of a classical theory depends on context. Classical physical concepts are often used when modern theories are unnecessarily complex for a particular situation. Most often classical physics refers to pre-1900 physics, while ***modern physics refers to post-1900 physics which incorporates elements of quantum mechanics and relativity*** .

There is no doubt that we cannot develop any scientific concept about the physical world without establishing a primary idea of **Space** and **Time**. Newton's primary notion of Space and Time is documented in his Principles of Mathematics:

Absolute Space, in its own nature, without regard to anything external, remains always similar and immovable. Relative Space is some movable dimension or measure of the absolute spaces; which our senses determine, by its position to bodies; and which is vulgarly taken for immovable space… And so instead of absolute places and motions, we use relative ones; and that without any inconvenience in common affairs; but in Philosophical disquisitions, we ought to abstract from our senses, and consider things themselves, distinct from what are only sensible measures of them. For it may be that there is nobody really at rest, to which the places and motions of others may be referred.

Absolute, True, and Mathematical Time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called Duration: Relative, Apparent, and Common Time is some sensible and external (whether accurate or unequable) measure of Duration by the means of motion, which is commonly used instead of True time; such as an Hour, a Day, a Month, a Year… All motions may be accelerated and retarded, but the True, or equably progress, of Absolute time is liable to no change.

Euclidean Space is the fundamental space of geometry, intended to represent **Physical Space**. Originally, it was the **three-dimensional space of Euclidean geometry**.

In mathematical physics, **Minkowski Spacetime** is a combination of three-dimensional **Euclidean Space** and **Time** into a four-dimensional manifold where the spacetime interval between any two events is independent of the inertial frame of reference in which they are recorded. Although initially developed by H. Minkowski for Maxwell's equations of electromagnetism, the mathematical structure of Minkowski spacetime was shown to be implied by the postulates of Special Relativity.

Minkowski spacetime is closely associated with Einstein's theories of **Special Relativity** and **General Relativity** and is the most common mathematical structure on which special relativity is formulated. Because it treats time differently than it treats the 3 spatial dimensions, Minkowski spacetime differs from four-dimensional Euclidean space.

In physics, the **Gravity** is a fundamental interaction which causes mutual attraction between all things with mass or energy. Gravity is by far the weakest of the four fundamental interactions. As a result, it has no significant influence at the level of subatomic particles. However, gravity is the most significant interaction between objects at the **Macroscopic Scale,** and it determines the motion of planets, stars, galaxies, etc.

General Relativity describes Gravity not as a force, but as the curvature of spacetime, caused by the uneven distribution of mass, and causing masses to move along geodesic lines. The most extreme example of this curvature of spacetime is BH, from which nothing—not even light—can escape once past the BH's event horizon. However, for most applications, gravity is well approximated by Newton's law of universal gravitation.

Scientists are currently working to develop a theory of gravity consistent with quantum mechanics, a quantum gravity theory, which would allow gravity to be united in a common mathematical framework (a **theory of everything**) with the other three fundamental interactions of physics.

In physics, the **Principle of Relativity** is the requirement that the equations describing the laws of physics have the same form in all admissible frames of reference (including inertial forces). For example, in the framework of special relativity the Maxwell equations have the same form in all inertial frames of

reference. In the framework of general relativity the Einstein field equations have the same form in arbitrary frames of reference.

In modern physical cosmology, the cosmological principle **Universality of Physical Laws** is the notion that the spatial distribution of matter in the universe is homogeneous and isotropic when viewed on a large enough scale, since the forces are expected to act uniformly throughout the universe, and should, therefore, produce no observable irregularities in the large-scale structuring over the course of evolution of the matter field that was initially laid down by BBM.

In physics, a **Conservation Law** states that a particular measurable property of an **isolated physical system** does not change as the system evolves over time. **Exact Conservation Laws** include conservation of mass and energy, conservation of linear momentum and angular momentum, and conservation of electric charge.

One particularly important result concerning conservation laws is **Noether theorem**, which states that there is a one-to-one correspondence between each one of them and a differentiable symmetry of nature:

- Conservation of energy follows from the time-invariance of physical systems;
- Conservation of linear momentum follows from the space-translation invariance (translation along x, y, z directions);
- Conservation of angular momentum arises from the fact that physical systems behave the same way regardless of how they are oriented in space (rotation invariance - rotation about x, y, z axes).

6.2. Paradigm Shift for Classical Physics [27]

Classical Physics is a branch of Physics that should be described by classical notions, which define emergent phenomena. An **Emergent Phenomenon** is a property that is a result of simple interactions that work cooperatively to create a more complex interaction. Physically, simple interactions occur at a microscopic level, and the collective result can be observed at a macroscopic level. WUM introduces classical notions, when the very first ensemble of particles was created at the cosmological time $\tau_M \cong 10^{-18}\ s$ and become possible to introduce the notion "**Medium of the World**". We emphasize that Classical Physics is principally different from Quantum Physics that describes quantum objects, which have only four-momenta. **Classical Physics is dealing with ensembles of quantum objects!**

The World is a **3D Hypersphere of the 4D Nucleus of the World**, which is expanding in Its fourth spatial dimension. As the result, the Hypersphere is evenly stretched. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World. A Hypersphere is an example of a **3-Manifold** which locally behaves like regular Euclidean 3D space: just as a sphere looks like a plane to small enough observers. The **3D Finite Boundless World** has a **Spatial Measure** – Radius of the curvature in the fourth spatial dimension R. All spatial parameters of the World can be measured relatively to R. Any cosmological model of the Infinite Universe has no Spatial Measure.

WUM introduces a **Cosmological Time** τ that is principally different from the **Solar Time** t (which is defined by the parameters of SS: the Rotation of the Earth around its own axis – day and the Sun – year) and **Cosmic Time** of the General Relativity. It is defined by the **Impedance** (Wave Resistance) of the Medium of the World that equals to the Hubble's parameter $H = \tau^{-1}$. Cosmological Time marches on at constant pace since the Beginning of the World until the present Epoch and defines the Age of the World $A_\tau = \tau$. All time-varying parameters of the World can be measured relatively to the Age of the World.

According to WUM:

- The World's energy density is $\rho_W \propto \tau^{-1}$ in all cosmological times;
- The particles relative energy densities are proportional to the dimensionless Rydberg constant α ;
- All time-varying PCPs of the World: Gravitation, Hubble's, Concentration of IGP, Temperature of MBR, etc. have values that reversibly depend on cosmological time τ .

WUM concludes that any theory of evolution of the World should be consistent with the Cosmological Time. In the Classical Physics and our everyday life we use an **alleged Space (3D Euclidean) and Solar Time** $\boldsymbol{t}$.

Time-Varying Gravitational parameter $G \propto \tau^{-1}$ that is proportional to the Mediums' energy density can be introduced only for the Medium filled with Matter. The Gravitation is a result of simple interactions of DMPs with Matter (by the introduced new **Weak interaction**) that work cooperatively to create a more complex interaction. DMPs are responsible for Le Sage's mechanism of the gravitation. **Gravity is not an interaction but a manifestation of the Medium.**

WUM states a **Supremacy of Matter**: **Time, Space and Gravitation** have no separate existence from Matter. They are closely connected with the Impedance, Gravitomagnetic parameter, and Energy density of the Medium of the World respectively. Gravitation, Space and Time are all emergent phenomena. In this regard, it is worth recalling A. Einstein quote: "*When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter*".

It turned out that abandoning of the Luminiferous Aether in 1905 was crucial for the Classical Physics. It is a great pity that the mainstream physicists at that time did not know (or forgot) a theory developed by J. McCullagh in 1846. He proposed a **Theory of a rotationally elastic medium**, i.e. a medium in which the potential energy of deformation depends only on the rotation of the volume elements and not on their compression or general distortion.

Principle of Relativity is valid because the Medium of the World is an absolute frame of reference. Then, there is no need to discuss Special Relativity and General Relativity, which abandoned the Aether in 1905.

The Cosmological Principal **Universality of Physical Laws** is valid at the cosmological times $\tau \geq \tau_M$ because they are determined by the Medium of the World. It is valid for the Homogeneous and Isotropic Medium of the World consisting of elementary particles with 2/3 of the total Matter. The distribution of MOs with 1/3 of the total Matter is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous, and therefore, the Cosmological Principal is not viable for the entire World.

Conservation Laws of Energy, Linear Momentum and Angular Momentum are not **Exact Conservation Laws** because the World is not an isolated physical system and is continuously getting Dark Matter from the Eternal Universe.

WUM is based on **Maxwell's Equations** (MEs) that form the foundation of classical Electrodynamics and Gravitomagnetism. The Einstein field equations are nonlinear MEs in the strong field limit. In MEs, there are no notions "Charge" and "Energy" but there are "**Charge Density**" and "**Energy Density**". MEs produce only two physically measurable quantities: **energy density and energy flux density**.

Angular Momenta of MOs are due to the Explosive Volcanic Rotational Fission of Overspinning DM Supercluster's Cores.

As a conclusion:

- The proposed new Primary Notions are, in fact, a Paradigm Shift for Classical Physics.
- Based on the totality of results obtained by WUM, we suggest adopting the existence of Dark Matter and the Medium of the World that is the Savior of the Classical Physics.

Conclusion

WUM is based on two parameters only: dimensionless Rydberg constant α and time-varying quantity Q. In WUM we often use well-known physical parameters, keeping in mind that all of them can be expressed through the Basic Units of time t_0, size a, and energy E_0. Taking the relative values of physical parameters in terms of the Basic Units we can express all dimensionless parameters of the World through two parameters α and Q in various rational exponents, as well as small integer numbers and π. There are no Fundamental Physical Constants in WUM. In our opinion, constant α and quantity Q should be named "Universe Constant" and "World Parameter" respectively.

WUM does not attempt to explain all available cosmological data, as that is an impossible feat for any one article. Nor does WUM pretend to have built an all-encompassing theory that can be accepted as is. The Model needs significant further elaboration, but in its present shape, it can already serve as a basis for a Paradigm Shift for Cosmology and Classical Physics. The Model should be developed into the well-elaborated theory by the entire physical community.

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