

# Cosmology and Classical Physics. Summary

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## Abstract

In 1937, Paul Dirac proposed Large Number Hypothesis and Hypothesis of Variable Gravitational Constant, and later added notion of Continuous Creation of Matter in World. Hypersphere World-Universe Model (WUM) follows these ideas, albeit introducing different mechanism of Matter creation. In this paper, we show that WUM is natural continuation of Classical Physics. WUM is proposed as an alternative to prevailing Big Bang Model (BBM) that relies on General Relativity.

WUM and BBM are principally different Models:

1) Instead of Initial Singularity with infinite energy density and extremely rapid expansion of spacetime (Inflation) in BBM; in WUM, there was Fluctuation (4D Nucleus of World with extrapolated radius equals to basic size unit of  $a$ ) in Eternal Universe with finite extrapolated energy density ( $\sim 10^4$  less than nuclear density) and finite expansion of Nucleus in Its fourth spatial dimension with speed  $c$  that is gravitodynamic constant;

2) Instead of alleged practically Infinite Homogeneous and Isotropic Universe around Initial Singularity in BBM; in WUM, 3D Finite Boundless World (Hypersphere of 4D Nucleus) presents Patchwork Quilt of various Luminous Superclusters ( $\geq 10^3$ ), which emerged in different places of World at different Cosmological times. Medium of World, consisting of protons, electrons, photons, neutrinos, and dark matter particles, is Homogeneous and Isotropic. Distribution of Macroobjects is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous.

Most direct observational evidence of validity of WUM are:

1) Microwave Background Radiation and Intergalactic Plasma speak in favor of existence of **Medium**;

2) Laniakea Supercluster with binding mass  $\sim 10^{17} M_{\odot}$  is home to Milky Way (MW) galaxy and  $\sim 10^5$  other nearby galaxies, which did not start their movement from Initial Singularity;

3) MW is gravitationally bounded with Virgo Supercluster (VSC) and has **Orbital Angular Momentum** calculated based on distance of 65 *Mly* from VSC and orbital speed of  $\sim 400 \text{ km s}^{-1}$ , which far exceeds rotational angular momentum of MW;

4) Mass-to-light ratio of VSC is  $\sim 300$  times larger than that of Solar ratio. Similar ratios are obtained for other superclusters. These ratios are main arguments in favor of presence of significant amounts of **Dark Matter** in World.

5) Astronomers discovered the most distant galaxy HD1 that is  $\sim 13.5 \text{ Bly}$  away. WUM predicts discovery of galaxies with distance  $\sim 13.8 \text{ Bly}$ .

**Medium of World, Dark Matter, and Angular Momentum are main Three Pillars of WUM.**

## Introduction

WUM is proposed as an alternative to the prevailing BBM. 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 for time  $< 10^{-32} \text{ s}$ . The size of the whole universe is unknown, and it might be infinite in extent.

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

In our view, there is no way to prevent an occurrence of the initial singularity in BBM. A **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 a 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 (see Section 4.2). 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 World's energy – the Eternal Universe. 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. 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]-[27] (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** (see Section 5.2).

**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**  $R_\infty$  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,  $R_\infty$  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** ( $h$ ) was suggested by M. Planck as the result of 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). 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  $R_\infty$ ,  $R_T$ ,  $c$ ,  $h$ , and the value of permeability of free space:  $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$  we calculate the most important Fundamental constants: **Basic size unit**  $a$ , including **Classical electron radius**  $a_0 = a/2\pi$ ; **Dimensionless Rydberg constant**  $\alpha$  that was later named “Fine-structure constant”; **Mass of electron**  $m_e$ ; **Elementary charge**  $e$ . All these constants 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;
- 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*;
- 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;
- 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. 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% of all the angular momentum in SS is concentrated in the planets. Jupiter itself has 60% 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 Sun could be transferred to 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 Moon by rapidly spinning Earth, on which equatorial gravitative attraction was nearly overcome by centrifugal force.

## Part II. Bing Bang Model

### 2.1. Framework for Big Bang Model [7] [15] [16] [24] [26]

The framework for BBM relies on General Relativity and on simplifying assumptions such as homogeneity and isotropy of space. The Lambda Cold Dark Matter ( $\Lambda$ CDM) model is a parametrization of BBM in which the universe contains three major components: first, a Cosmological constant  $\Lambda$  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 1984, G. Blumenthal, *et al.* wrote: "*We have shown that a universe with  $\sim 10$  times as much cold dark matter as baryonic matter provides a remarkably good fit to the observed universe*;
- 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, **Cold dark matter in the form of some unknown species of elementary particle had become the leading paradigm.**

The  $\Lambda$ CDM model is based on six parameters, the values of which are mostly not predicted by current theory. The Four Pillars of BBM are as follows:

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

### 2.2. Expansion of Universe

There is now excellent evidence for the expansion of universe. 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 BBM – 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 Cosmological Inflation, which is a theory of an extremely rapid expansion of space in the early universe up to 93 billion light-years in diameter for time  $< 10^{-32}$  s .

*"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.*

### 2.3. Origin of Cosmic Background Radiation

According to BBM, about 380,000 years after BB a 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. The photons that existed at that time have been propagating ever since, though growing fainter and less energetic, since the expansion of space causes their wavelength to increase over time. These photons 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.

## 2.4. Nucleosynthesis of Light Elements

Big Bang Nucleosynthesis refers to a production of nuclei other than those of hydrogen during early phases of universe. Primordial nucleosynthesis is calculated to be responsible for a formation of most of the universe's helium-4, along with small amounts of deuterium, helium-3, and lithium-7. All of the elements that are heavier than lithium were created much later, by stellar nucleosynthesis in evolving and exploding stars.

During the 1970s, there were major efforts to find processes that could produce deuterium. 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.

In case of lithium, astronomers 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  ${}^2\text{H}(\alpha,\gamma){}^6\text{Li}$  cross section at BB energies. Their results have firmly **ruled out BBN lithium production** as a possible explanation for the reported  ${}^6\text{Li}$  detections.

In frames of **WUM**, Nucleosynthesis of all elements (including light elements) occurs inside of DM Cores of all Macroobjects(MOs) during their evolution (see Section 4.2)

## 2.5. 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. 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 BBM – 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:** The performed analysis shows that the Four Pillars are model-dependent and not strong enough to support BBM.

## 2.6. 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. BBM cannot answer the following questions:

- Sun accounts for  $\sim 0.3\%$  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 VSC 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, BBM does not answer these questions. **WUM is the only cosmological model in existence that is consistent with this Fundamental Law** (see Section 4.2).

## 2.7. Black Holes [1][16] [23][27]

Black Hole (BH) is a **mathematical solution** of Einstein's field equations. 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). 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\*. 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 SBH.

In our opinion, the results obtained by EHT 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?
- The MW galaxy (including Sgr A\*) is gravitationally bounded with VSC 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.

**As a conclusion:** The totality of all obtained experimental results testify in favor of the existence of the **Supermassive Compact Object** made up of DMPs at MW Center.

## Part III. Hypotheses Revisited by WUM

### 3.1. Aether [12]

Aether was suggested by I. Newton. Following the work of T. Young and A-J. Fresnel it was believed that light propagates as a transverse wave within an elastic medium called Luminiferous Aether. It was realized that Aether could not be an elastic matter of an ordinary type that can transmit longitudinal waves. Unique properties of Aether were discussed by J, McCullagh in 1846 who proposed a theory of a rotationally elastic medium with a potential energy of deformation that depends on a rotation of 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. Luminiferous Aether was abandoned in 1905 by SR. 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 existence of the Medium is a principal point of WUM. It follows from the observations of IGP and MBR. 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 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.

### 3.2. 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 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<sup>7</sup>th part of their mutual distance, so the particles can travel through them nearly unhindered.

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 3.6). 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 4.2). 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.

### 3.3. 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.

### 3.4. Gravitoelectromagnetism [11] [27]

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 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 Gravitomagnetism. The explanation of galactic rotation curve made by G. O. Ludwig is in good agreement with the approach of WUM.

### 3.5. 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 is inversely proportional to the cosmological time  $\tau$ :  $G \propto \tau^{-1}$ .

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  $A_\tau$  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,  $Q = 0.759972 \times 10^{40}$ .

### 3.6. Emergent Gravity, Space and Time [12]

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.

## Part IV. Hypersphere World-Universe Model

### 4.1. Assumptions

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  $\alpha$  and dimensionless quantity  $Q$  that is a measure of the Size  $R$  and Age  $A_\tau$  of the World and is, in fact, the Dirac Large Number.



## 4.2. Principal Points [9] [10] [19] [21] [22]

**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 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 so that Its radius is increasing with speed  $c$  that is the gravitodynamic constant. Its surface, the 3D Hypersphere, is evenly stretched. The stretching of It can be understood through the analogy with an 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 a result of this process. Sublimation is a well-known endothermic process that happens when surfaces are intrinsically more energetically favorable than a 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. 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 a surface energy), we can imagine that 3D Hypersphere World has a "Surface Energy" of 4D Nucleus. A grows of the surface of 4D Nucleus means an increase of the World's "Surface Energy".

The proposed 4D process is responsible for 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, 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.

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

**Rotational Fission** of overspinning (surface speed at equator exceeding escape velocity) Prime Objects is the mechanism that can provide Angular Momenta to MOs. 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 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 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 ( $\geq 10^3$ ), 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.

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

### 4.3. Predictions and Explained Problems [1]-[7] [14] [17] [23]

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.

#### 4.3.1. Newtonian Constant of Gravitation

The very first manuscript “World-Universe Model” (WUM) was uploaded on viXra in March 2013. At that time, the most important for 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  $G$ :

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

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

In 2013, WUM proposed a principally different way to solve the problem of  $G$  measurement precision based on the value of Fermi Coupling constant in 2010:

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

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 value of  $G(2014)$ :

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

**In 2018**, the recommendation improved further:

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

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:

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

WUM calculated the predicted value of gravitational constant  $G_{2018}^*$  :

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

that is in excellent agreement with the experimentally measured by Q. Li, *et al.* in 2018 value of  $G(Li)$  :

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

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

### 4.3.2. Hubble's Constant

The results of measurements of the Hubble's constant  $H_0$  , 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;
- There are observations of various characteristics of Galaxies that belong to different Superclusters, the distribution of which in the World is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous.

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 MBR** that depends on 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 perturbations in It. The calculated value of Hubble's constant in 2013:  $H_0 = 68.733 \text{ km/s Mpc}$  is in excellent agreement with the measured value in 2021:  $H_0 = 68.7 \pm 1.3 \text{ km/s Mpc}$  using only MBR data.

### 4.3.3. Missing Baryon

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

An existence of the Medium is a principal point of **WUM**. It follows from observations of MBR and IGP. Detailed analysis of IGP carried out in 2013 showed that the relative energy density of protons in the Medium  $\Omega_p$  is:  $\Omega_p = 2\pi^2 \alpha/3$ . In our opinion, direct measurements of 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  $\Omega_{IGM}$ :  $\Omega_{IGM} = 4.9 \pm 1.3\%$  that is in excellent agreement with the predicted by WUM in 2013 value of  $\Omega_p = 4.8014655\%$ .

#### 4.3.4. Minimum Energy of Photons

Analysis of IGP shows that the value of the lowest plasma frequency  $\nu_{pl}$  is:

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

Photons with energy smaller than  $E_{ph} = h\nu_{pl}$  cannot propagate in plasma, thus  $h\nu_{pl}$  is the minimum energy of photons which can pass through IGP:

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

The above value, predicted by WUM in 2013, is in good agreement with the value obtained by L. Bonetti, *et al.* in 2017:  $E_{ph} \approx 2.2 \times 10^{-14} \text{ eV}$ .

#### 4.3.5. Black-Body Spectrum of MBR

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  $T_{MBR}$ :

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

that is in excellent agreement with the measured value of  $2.72548 \pm 0.00057 \text{ K}$ .

#### 4.3.5. 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  $T_{FIRB}$ :

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

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

#### 4.3.6. 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*”. In 2020, R. Genzel and A. Ghez confirmed this prediction by: “The Discovery of a **Supermassive Compact Object** at the Centre of Our Galaxy”.

#### 4.3.7. Rest Energies of DMPs

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.

#### 4.3.8. 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 Extrasolar Systems 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 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. Solar wind is the result of this mechanism;
- **Diversity and Internal Heating of Gravitationally-Rounded Objects** in SS is explained by DM 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;
- **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 DM cores absorb new DMPs, size of MOs  $R_{MO}$  and their luminosity  $L_{MO}$  are increasing in time  $R_{MO} \propto \tau^{1/2}$  and  $L_{MO} \propto \tau$  respectively. 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  $\mu\text{m}$  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.

## Part V. Classical Physics

### 5.1. Primary Notions [Wikipedia]

According to Wikipedia, **Classical Physics** *is a group of physics theories that predate modern, more complete, or more widely applicable theories. 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". **Euclidean Space** is the fundamental space of geometry, intended to represent Physical Space. Originally, it was three-dimensional space of Euclidean geometry.

In mathematical physics, **Minkowski Spacetime** is a combination of 3D Euclidean Space and Time into a four-dimensional manifold where a spacetime interval between any two events is independent of the inertial frame of reference in which they are recorded. Minkowski spacetime is closely associated with Einstein's theories of **Special Relativity** (SR) and **General Relativity** (GR). Because it treats time differently than it treats spatial dimensions, the Minkowski spacetime differs from four-dimensional Euclidean space.

**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. GR 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. However, for most applications, gravity is well approximated by Newton's law of gravitation.

**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 SR the Maxwell's equations have the same form in all inertial frames of reference. In the framework of GR the Einstein's field equations have the same form in arbitrary frames of reference.

**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.

**Conservation Law** states that a particular measurable property of an **isolated physical system** does not change as a system evolves over time. **Exact Conservation Laws** include conservation of 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).

## 5.2. Classical Physics in WUM

**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!**

World is **3D Hypersphere of 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. The 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. **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**  $\tau$  that is principally different from a **Solar Time**  $t$  (which is defined by the parameters of SS) and **Cosmic Time** of GR. 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  $A_\tau = \tau$ . In Classical Physics and our everyday life we use an **alleged Space (3D Euclidean) and Solar Time  $t$** . 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 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.**

**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 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.

**Principle of Relativity** is valid because the Medium of the World is an absolute frame of reference. Then, there is no need to discuss SR and GR.

**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. Its parameters do not practically depend on MOs, which can create some perturbations in It. 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 DM from the Universe.

WUM is based on **Maxwell's Equations** (MEs) that form a foundation of Classical Electrodynamics and Gravitomagnetism. The Einstein's 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.

## Conclusion

WUM is based on two parameters only: dimensionless Rydberg constant  $\alpha$  and time-varying quantity  $Q$ . The World's energy density is proportional to  $Q^{-1}$  in all cosmological times. Particles relative energy densities are proportional to  $\alpha$ . 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  $\alpha$  and  $Q$  in various rational exponents, as well as small integer numbers and  $\pi$ . There are no Fundamental Physical Constants in WUM. In our opinion, constant  $\alpha$  and quantity  $Q$  should be named "Universe Constant" and "World Parameter" respectively.

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.

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. The Model should be developed into the well-elaborated theory by the entire physical community.

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