Development of Hypersphere World-Universe Model. Narrative. Part IX. Basic Notions of Classical Physics

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Abstract

Hypersphere World-Universe Model is consistent with all Concepts of the World. The Model successfully describes primary cosmological parameters and their relationships. WUM allows for precise calculation of values that were only measured experimentally earlier and makes verifiable predictions. The remarkable agreement of calculated values with the observational data gives us considerable confidence in the Model.

Great experimental results and observations achieved by Astronomy in last decades should be analyzed through the prism of WUM. Considering the JWST discoveries, successes of WUM, and 86 years of Dirac's proposals, it is high time to make a Paradigm Shift for Cosmology and Classical Physics.

Basic Notions of Classical Physics

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Abstract

Classical Physics is the 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. The developed World-Universe Model (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 four-momenta only. **Classical Physics is dealing with ensembles of quantum objects!**

The present paper discusses the Basic Notions of Classical Physics considering a principally different cosmological model WUM, which is, in fact, a Paradigm Shift for Cosmology. WUM is a natural continuation of Classical Physics, and it can already serve as a basis for a New Cosmology proposed by Paul Dirac in 1937.

Introduction

According to **Wikipedia** [1]:

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.

According to **WUM** [2]:

Classical Physics is dealing with ensembles of quantum objects! How Classical Physics can incorporate elements of quantum mechanics in Modern Physics? To be clear, we would like to provide a couple examples:

- 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. The **temperature** of the ideal gas (that is a classical notion) is proportional to the **average kinetic energy of its particles** [3]. The "temperature" knows nothing about movement of each particle, and particles have kinetic energies only. They have no idea about the "temperature";

- In 1965, A. Penzias and R. Wilson discovered Cosmic Microwave Background Radiation (MBR). According to Big Bang (BB) Model, about 380,000 years after BB 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 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? What is the mechanism of photons wavelength increasing over time and growing fainter and less energetic?

- According to WUM, wavelength is a classical notion (see Section 2.4). Photons, which are quantum objects, have four-momenta only. They do not have wavelengths. By definition, **Black-body radiation is 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, the existence of which is experimentally proved.

Part I. Classical Physics before Special Relativity [2]
1.1. Space and Time

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 a 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, a 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** 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 **WUM**, the World is a **3D Hypersphere of 4D Nucleus of the World**, which is expanding in Its fourth spatial dimension. As a result, 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 the **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 **Absolute Cosmological Time** τ measured from the Beginning of the World (14.22 Byr ago) like **Absolute Temperature** measured from the absolute zero in Kelvins. It is principally different from the **Solar Time** t, which is defined by the parameters of the Solar System 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 (see Section 2.3). Cosmological time equals to : $\tau = H^{-1}$. It 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.

In Classical Physics and our everyday life we use an alleged Space (3D Euclidean) and Solar Time t. Time is not a physical dimension and is absolutely different entity than Space. **Time is a Factor** of the World.

In 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 (see Sec. 2.3).

1.2. Aether

According to **Timeline of luminiferous aether**, Wikipedia [4]:

17th century: Robert Boyle was a proponent of an aether hypothesis. According to Boyle, the aether consists of subtle particles, one sort of which explains the absence of vacuum and the mechanical interactions between bodies, and the other sort of which explains phenomena such as magnetism (and possibly gravity) that are, otherwise, inexplicable on the basis of purely mechanical interactions of macroscopic bodies;

1690 – C. Huygens's Treatise on Light hypothesized that light is a wave propagating through an aether;

1704 – Isaac Newton publishes Opticks, in which he proposes a particle theory of light. This had trouble explaining diffraction, so he adds a "fudge factor," claiming that an "Aethereal Medium" is responsible for this effect, and going further to suggest it might be responsible for other physical effects such as heat;

1727 – James Bradley measures stellar aberration for the first time, proving (again) that light has a finite speed as well as that the Earth is moving;

1818 – Augustin Fresnel introduces the wave theory of light, which proposes light is a transverse wave travelling in an aether, thereby explaining how polarization can exist. It is important to note that both Newton's particle theory and Fresnel's wave theory both assume an aether exists, albeit for different reasons. From this point on, no one even seems to question its existence;

1904 – Hendrik Lorentz publishes a new theory of moving bodies, without discarding the stationary (electromagnetic) ether concept;

1905 – Henri Poincaré shows that Lorentz's theory fulfills the principle of relativity and publishes the Lorentz transformations. His model was still based on Lorentz's ether, but he argues that this aether is perfectly undetectable;

1905 – Albert Einstein publishes an observationally equivalent theory, but complete with a derivation from principles alone (leaving the ether aside). Einstein also emphasized that this concept implies the relativity of space and time. He later labelled it Special Relativity.

Following the work of T. Young (1804) and A-J. Fresnel (1818), 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. The Friedmann equations were first derived in 1922 from Einstein's field equations for the Friedmann–Lemaitre–Robertson–Walker metric and a **perfect fluid** with a given mass density ρ and pressure p, which is a **medium** of the universe.

It turned out that abandoning the Luminiferous Aether 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. 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 article in Nature "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 composed of stable elementary particles: protons, electrons, photons, neutrinos, and Dark Matter Particles (DMPs). The existence of the Medium is a principal point of WUM. It follows from the observations of Inter-Galactic Plasma, MBR, Far-Infrared Background 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. Then, there is no need in frames of reference of Special Relativity. 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.

Medium of the World is the Savior of Classical Physics! Don't throw the baby out with the bathwater.

1.3. Dark Matter

The history of Dark Matter (DM) can be traced back to at least the end of the 18th century. In a paper for the Philosophical Transactions of the Royal Society of London, read on 27 November 1783 [5], J. Michell was the first to propose the existence of "dark stars". Michell suggested that there might be many "dark stars" in the universe and proposed that astronomers could detect "dark stars" by looking for star systems which behaved gravitationally like two stars, but where only one star could be seen. Michell argued that this would show the presence of a "dark star". It was an extraordinarily accurate prediction of binary systems, in which a "dark star" and a normal star orbit around their center of mass. In the Milky Way (MW) galaxy there are a dozen such binary systems emitting X-rays [6]. In WUM, **DM Cores of all MOs are, in fact, "Dark Stars".**

G. Bertone and D. Hooper provide an excellent review of this history [7]:

- 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.

WUM proposes multicomponent DM system consisting of two couples of co-annihilating 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 elementary charge and α is dimensionless Rydberg constant, see Section 2.5); 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; DMF3 (3.7 keV), DMF4 (0.2 eV), and boson XION (10.6 μeV) [13].

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 and DM Reactors in WUM [2].

We still do not have a direct confirmation of DMPs' rest energies, but we do have a number of indirect observations. The signatures of DMPs self-annihilation with expected rest energies of 1.3 TeV; 9.6 GeV; 70 MeV; 340 keV; 3.7 keV are found in spectra of the diffuse gamma-ray background and the emissions of various Macroobjects in the World. We connect observed gamma-ray spectra with the structure of Macroobjects (nuclei and shells composition). Self-annihilation of those DMPs can give rise to any combination of gamma-ray lines. Thus, the diversity of Very High Energy gamma-ray sources in the World has a clear explanation [9]. DMPs do not possess an electric charge. Their masses cannot be directly measured by mass spectrometry. Hence, they can be observed only indirectly due to their self-annihilation and irradiation of gamma-quants.

1.4. Gravity

In 1684, Newton sent a manuscript to Edmond Halley titled "De motu corporum in gyrum" (On the motion of bodies in an orbit), which provided a physical justification for Kepler's laws of planetary motion.

Halley was impressed by the manuscript and urged Newton to expand on it, and a few years later Newton published a groundbreaking book called "Philosophiæ Naturalis Principia Mathematica" (Mathematical Principles of Natural Philosophy). In this book, Newton described gravitation as a universal force, and claimed that "the forces which keep the planets in their orbs must [be] reciprocally as the squares of their distances from the centers about which they revolve" [10].

Le Sage's Theory of Gravitation. Wikipedia summarizes this unique theory as follows [11]:

"Le 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. In order to achieve exact mass proportionality as in Newton's theory (which implies no shielding or saturation effects and an infinitely porous structure of matter), the ultramundane flux must be infinitely intense.

Le Sage's theory is the very first theory which defines the Gravity as an emergent phenomenon.

In **WUM**, the time-varying Gravitational parameter $G \propto \tau^{-1}$ is proportional to the energy density of the Medium $\rho_M \propto \tau^{-1}$. It is not a constant. That is why WUM aligns gravity with Le Sage's theory of gravitation. WUM gives for Le Sage's Theory the following parameters [8]:

- XIONs ($10.6 \ \mu eV$) are "ultramundane corpuscles";
- XIONs are ultra-relativistic DM particles;
- Proposed Weak interaction between XIONs and Matter provides mass proportionality. Energy density of XIONs in the World about 64% of the total energy density provides high intensity of their flux;
- Gravitational mass m_g is a classical notion that defines Gravity – the emergent phenomenon. m_g is an analog of temperature T that defines macroscopic properties of gases. We emphasize that an inertial mass m_i that is a coefficient of proportionality between a force F and an acceleration a: $F = m_i a$, has nothing to do with m_g.

According to Wikipedia: *Although inertial mass, passive gravitational mass and active gravitational mass are conceptually distinct, no experiment has ever unambiguously demonstrated any difference between them. In classical mechanics, Newton's third law implies that active and passive gravitational mass must always be identical (or at least proportional), but the classical theory offers no compelling reason why the gravitational mass has to equal the inertial mass. That it does is merely an **empirical fact**.*

*Albert Einstein developed his general theory of relativity starting with the **assumption** that the inertial and passive gravitational masses are the same. This is known as the equivalence principle* [12].

Gravity is not an interaction but a manifestation of the Medium.

Part II. WUM – Continuation of Classical Physics

2.1. Emergent Gravity, Space and Time [2]

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 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: In our model, the Medium of the World is not fundamental and has macroscopic parameters like in fluid mechanics: impedance, gravitomagnetic parameter, energy density, etc. 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. WUM confirms the **Supremacy of Matter** postulated by Albert Einstein: *When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter.*

2.2. Decisive Role of Gravitational Parameter G in Cosmology [13]

Maxwell's Equations (MEs) form the foundation of classical Electrodynamics. Gravitomagnetism (GM) is a gravitational analog of Electromagnetism (EM). GM equations differing from MEs by some constants were first published by O. Heaviside in 1893 as separate theory expanding Newton's law. GM is an approximation to 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 this analogy between EM and relativistic gravity. MEs produce only two physically measurable quantities: energy density and energy flux density.

The value of MEs is even greater because J. Swain showed that "*linearized general relativity admits a formulation in terms of gravitoelectric and gravitomagnetic fields that closely parallels the description of the electromagnetic field by Maxwell's equations*". We emphasize that **GM considers not only interactions between masses but also between mass currents**, which produce gravitomagnetic field.

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* .

WUM is based on GM. The explanation of the galactic rotation curve made by G. O. Ludwig is in good agreement with the approach of WUM. Thanks to the revealed by WUM Inter-Connectivity of Primary

Cosmological Parameters, we show that Gravitational parameter G that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly.

It is worth noting that in WUM, parameter G is proportional to the energy density of the Medium of the World ρ_M that is inversely proportional to the cosmological time: $\rho_M \propto \tau^{-1}$. Therefore, parameter $G \propto \tau^{-1}$, as it was discussed by P. Dirac in 1937. Introduced by WUM, Cosmological time marches on at constant pace since the Beginning of the World (14,22 Byr ago) until the present Epoch and defines the Age of the World: $A_\tau = \tau$. The Hubble's parameter H, which is, in fact, Wave Resistance of the Medium, equals to: $H = \tau^{-1}$ and should be measured using MBR data only (see Section 2.3).

We emphasize that in frames of WUM, there is no need to invent new Physical Laws for describing early stages of the World observed by JWST. We can use the well-known equations considering a time-varying G.

2.3. Gravitomagnetism [14]

Maxwell's equations (MEs) vary with the unit system used. Although the general shape remains the same, various definitions are changed, and different constants appear in different places. We start our discussion with MEs in SI units. We will not rewrite well-known equations, but only provide the relationships between physical quantities used in MEs for EM and GM in Table **1** and Table **2.**

Table 1. Electromagnetism (EM)

Charge	Impedance of Electromagnetic Field	Magnetic Flux
q, C	$Z_0 = \sqrt{\dfrac{\mu_0}{\varepsilon_0}} = \mu_0 c \,, \Omega$	ϕ_q, Wb
Electric Current	**Magnetic Constant**	**Electric Potential**
I_q, A	$\mu_{0,} Hm^{-1}$	U_q, V
Magnetic Field Intensity	**Electric Constant**	**Electric Field**
H_q, Am^{-1}	$\varepsilon_0 = (\mu_0 c^2)^{-1}, \phi m^{-1}$	E_q, Vm^{-1}
Electric Flux Density	**Electrodynamic Constant**	**Magnetic Flux Density**
D_q, Cm^{-2}	c, ms^{-1}	B_q, Wbm^{-2}

Table 2. Gravitomagnetism (GM)

Mass	Impedance of Gravitational Field	Gravitomagnetic Flux
m, kg	$Z_g = \sqrt{\dfrac{\mu_g}{\varepsilon_g}} = \mu_g c$	$\phi_m, m^2 s^{-1}$
Mass Current	**Gravitomagnetic Parameter**	**Gravitoelectric potential**
I_m, kgs^{-1}	$\mu_g = 4\pi G/c^2$	$U_m, m^2 s^{-2}$
Gravitomagnetic Field Intensity	**Gravitoelectric Parameter**	**Gravitoelectric Field**
$H_m, kgm^{-1}s^{-1}$	$\varepsilon_g = (\mu_g c^2)^{-1}$	E_m, ms^{-2}
Gravitoelectric Flux Density	**Gravitodynamic Constant**	**Gravitomagnetic Flux Density**
D_m, kgm^{-2}	c, ms^{-1}	B_m, s^{-1}

In MEs, electrodynamic constant c is defined as the ratio of the absolute electrodynamic unit of charge to the absolute electrostatic unit of charge [15]. It is easy to see that the dimension of products (Charge × Magnetic Flux) and (Mass× Gravitomagnetic Flux) equals that of the Plank constant h (see Section 2.4).

9

From these **Tables** it becomes clear that the dimensions of all physical quantities depend on the choice of the charge and mass dimensions (Coulomb & kilogram in SI units). In other unit systems the dimensions are different. For instance, in Gaussian units (CGSE):

- $[q_e] = cm^{3/2}g^{1/2}s^{-1}$
- $[Z_e] = cm^{-1}s$

In CGSM:

- $[q_m] = cm^{1/2}g^{1/2}$
- $[Z_m] = cms^{-1}$

We seem to possess a substantial degree of freedom when it comes to choosing the dimension of charge. For an arbitrary dimension-transposing parameter P we can:

- Multiply the charge and mass and all physical quantities on the left side of **Tables** 1 and **2** by an arbitrary parameter P;
- Divide impedances by P^2;
- Divide magnetic fluxes and all physical quantities on the right side of **Tables 1** and **Table 2** by P.

Following such a transformation, all physically measurable parameters such as energy density and energy flux density remain the same and have the same mechanical dimensions.

By definition, one Coulomb equals to one tenth of the absolute electrodynamic unit of charge. It follows that in SI we use electrodynamic unit of charge e in the electrostatic Coulomb law instead of the electrostatic unit e/c. This seems a bit odd.

Likewise, when describing Newtonian law of gravitation, we use m – the gravitational mass, instead of the gravitodynamic charge mc^2. The gravitostatic charge is then mc. Similarly to the electromagnetic field, the gravitodynamic constant c is the ratio of the absolute gravitodynamic unit of charge E_0 to the absolute gravitostatic unit of charge E_0/c (see Section 2.5). It is worth noting that the speed of light in vacuum, commonly denoted as c, is not related to the World in our Model, because there is no vacuum in it. Instead, there is the Medium of the World consisting of elementary particles.

But there is a principal physical difference between EM and GM:

- In EM, the magnetic constant μ_0 and electric constant ε_0 are the permeability and permittivity of free space, correspondingly;
- In GM, the gravitomagnetic parameter μ_g depends on the gravitational parameter G:

$$\mu_g = \frac{4\pi G}{c^2}$$

which is not a constant in our model and cannot be introduced without the Medium of the World.

In frames of WUM, the gravitomagnetic parameter μ_g can be calculated based on the value of the energy density of the Medium of the World ρ_M:

$$\mu_g = \frac{4\pi G}{c^2} = \frac{\rho_M}{c^2} \times P^2$$

where a dimension-transposing parameter P equals to:

$$P = \frac{a^3}{2\hbar/c}$$

The gravitational parameter G equals to:

$$G = \frac{\rho_M}{4\pi} \times P^2$$

Then the Newton's law of universal gravitation can be rewritten in the following way:

$$F = G\frac{m \times M}{r^2} = \frac{\rho_M}{4\pi}\frac{\frac{a^3}{2L_{Cm}} \times \frac{a^3}{2L_{CM}}}{r^2}$$

where we introduced the measurable parameter of the Medium ρ_M instead of the phenomenological coefficient G; and gravitodynamic charges $m \times P = \frac{a^3}{2L_{Cm}}$ and $M \times P = \frac{a^3}{2L_{CM}}$ instead of macroobject masses m and M (L_{Cm} and L_{CM} are Compton length of mass m and M respectively). The gravitodynamic charges have a dimension of "Area", which is equivalent to "Energy", with the constant that equals to the basic unit of surface energy density $\sigma_0 = hc/a^3$ (see Section 2.5).

Using a substantial degree of freedom when it comes to choosing the dimension of "mass", we can:

- Multiply the mass and all physical quantities on the left side of **Table 2** by the parameter $P = \frac{a^3}{2h/c}$;

- Divide impedance by P ;

- All physical quantities on the right side of **Table 2** leave them as they are.

Following this approach, we can find the gravitomagnetic parameter of the Medium μ_M :

$$\mu_M = \frac{4\pi G}{Pc^2} = \frac{1}{R}$$

and the impedance of the Medium Z_M :

$$Z_M = \mu_M c = H$$

where H is the Hubble's parameter:

$$H = \frac{c}{R} = \frac{1}{\tau} \ .$$

As a result of this transformation:

- All parameters of the gravitomagnetic field have dimensions of "Length" and "Time"; "Mass" dimension has disappeared;

- All physical parameters of the World measured in terms of the basic unit of size a and the basic unit of time $t_0 = a/c$ become scalars (see Section 2.5);

- Absolute Size and Age of the World equal to a dimensionless time-varying quantity $Q = \frac{R}{a} = \frac{\tau}{t_0}$;

- The gravitodynamic charge has a dimension of "Area" which is equivalent to "Energy";

- The impedance of the Medium Z_M equals to the Hubble's parameter $Z_M = H$.

It follows that measuring the value of Hubble's parameter **anywhere** in the World (using MBR data only) and taking its inverse value allows us to calculate the absolute Age of the World. The Hubble's parameter is then the most important characteristic of the World, as it defines the Worlds' Age. While in our Model Hubble's parameter H has a clear physical meaning, the gravitational parameter G

$$G = \frac{a^3 c^3}{8\pi hc}H$$

is a phenomenological coefficient in Newton's law of universal gravitation (h is Planck constant).

The second important characteristic of the Medium of the World is the gravitomagnetic parameter $\mu_M = R^{-1}$. Taking its inverse value, we can find the radius of the 4D Nucleus characterizing the curved nature of the World.

We emphasize that parameters Z_M and μ_M are principally different physical characteristics of the Medium that are connected through the gravitodynamic constant $c : Z_M = \mu_M c$. It means that "Time" is not a physical dimension and is an absolutely different entity than "Space". Time is a Factor of the World.

2.4. Energy in Matter [16]

All particles in the World are fully characterized by their four-momentum $\left(\frac{E}{c}, \boldsymbol{p}\right)$ that satisfies the following equation:

$$\left(\frac{E}{c}\right)^2 - \boldsymbol{p}^2 = Inv = (mc)^2$$

In WUM, the invariant is, in fact, a gravitostatic charge mc squared, and E is the gravitodynamic charge. When the gravitostatic charge of particles equals to momentum p_{DB}, gravitomagnetic flux ϕ_{DB} is (see Section 2.3):

$$\phi_{DB} = \frac{h}{p_{DB}} = \lambda_{DB}$$

known as de Broglie wavelength. The notion of "Wavelength" is thus a macroscopic notion, namely, gravitomagnetic flux of particles characterized by four-momentum only. It means that there is no Wave–Particle duality in WUM. Hence wavelength is an emergent phenomenon [17].

We can rewrite the first equation as follows:

$$\left(\frac{E}{c}\right)^2 = \boldsymbol{p}^2 + (mc)^2$$

where mc is, in fact, the momentum of the particle in the fourth spatial dimension. In case of the motionless particle ($\boldsymbol{p} = 0$) in the absolute reference frame (3D Medium), the total gravitostatic charge $\left(\frac{E}{c}\right)$ equals to:

$$\left(\frac{E}{c}\right) = mc$$

Then, the gravitodynamic charge of the motionless particle E equals to (see Section 2.3):

$$E = \left(\frac{E}{c}\right) \times c = mc^2$$

that is named "rest energy". It means that particles have rest energies due to the expansion of the Nucleus of the World in the fourth spatial dimension with the speed c that is the gravitodynamic constant in WUM. In this regard, it is worth recalling the Nicola Tesla quote: *"There is no energy in matter other than that received from the environment. All this energy (sometimes viewed as "Zero Point Energy") comes from the environment giving life to matter, forming a "closed circuit" through one way or the other (being "accessed" more efficiently or less based on the methodology). It is omnipresent, day or night, and is "re-emitted" by every star in our universe naturally including our sun"* [18].

2.5. Fundamental Physical Constants [2]

Maxwell's equations were published by Maxwell in 1861. He calculated the velocity of electromagnetic waves from the value of an **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.**

We emphasize that c in Maxwell's equations **is the electrodynamic constant** but **not the speed of light in vacuum.** It is worth noting that the speed of light in vacuum, commonly denoted as c, is not related to the World in our Model, because there is no Vacuum in It. Instead, there is the Medium of the World consisting of stable elementary particles.

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.

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 measured by J. J. Thomson in 1897. We name it after Thomson: $R_T \equiv e/m_e$.

Planck Constant h was suggested by M. Planck in 1901 as the result of investigating the problem of black-body radiation. He used Boltzmann's 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).

Based on the **experimentally measured** values of the constants R_∞ , R_T , c , h , and the magnetic constant: $\mu_0 = 4\pi \times 10^{-7}\ H/m$ we make measurable the **most important 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 :

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

- Electron rest energy E_e :

$$E_e = \alpha hc/a$$

- Elementary charge e :

$$e^2 = 2\alpha h/\mu_0 c$$

All these Fundamental constants, including classical electron radius $a_o = a/2\pi$, could be calculated based on the experimentally measured constants before Quantum Physics! It is worth noting that the constant α was later named "Sommerfeld's constant" and later "Fine-structure constant."

In WUM we introduce the following Basic Units:

- Size $\qquad\qquad\qquad\qquad\qquad$ a
- Time $\qquad\qquad\qquad\qquad\qquad$ $t_0 = a/c$
- Energy $\qquad\qquad\qquad\qquad\quad$ $E_0 = hc/a$
- Surface Energy Density $\qquad\quad$ $\sigma_0 = hc/a^3$
- Energy Density $\qquad\qquad\quad$ $\rho_0 = hc/a^4$

2.6. Dirac Large Number Hypothesis [2]

In 1937, Paul Dirac in the paper "A new basis for cosmology" said [19]:

*"Since general relativity explains so well local gravitational phenomena, we should expect it to have some applicability to the universe as a whole. We cannot, however, expect it to apply with respect to the metric provided by the atomic constants, since with this metric the "gravitational constant" is not constant but varies with the epoch. We have, in fact, the ratio of the gravitational force to the electric force between electron and proton varying in inverse proportion to the epoch, and since, with our atomic units of time, distance and mass, the electric force between electron and proton at a constant distance apart is constant, the gravitational force between them must be inversely proportional to the epoch. Thus, the **gravitational constant will be inversely proportional to the epoch**".*

In Summary, he concluded:

*"It is proposed that all the **very large dimensionless numbers** which can be constructed from the important natural constants of cosmology and atomic theory **are connected by simple mathematical relations** involving coefficients of the order of magnitude unity. The main consequences of this assumption are investigated, and it is found that a **satisfactory theory of cosmology can be built up from it**".*

WUM follows the idea of time-varying G and introduces a dimensionless time-varying quantity Q, that is, in fact, the **Dirac Large Number**, which in present epoch equals to: $Q = 0.7599440 \times 10^{40}$. G can be calculated from the value of the parameter Q [13]:

$$G = \frac{a^2 c^4}{8\pi hc} \times Q^{-1} \propto \tau^{-1}$$

WUM holds that there indeed exist **simple mathematical relations** between all Primary Cosmological Parameters (PCPs) that depend on Q [20]:

- Newtonian parameter of gravitation G ;
- Age of the World A_τ ;
- The Worlds' radius of curvature in the fourth spatial dimension R ;
- Hubble's parameter H ;
- Critical energy density ρ_{cr} ;
- Concentration of Intergalactic Plasma n_{IGP} ;
- Minimum Energy of Photons E_{ph} ;
- Temperature of the Microwave Background Radiation T_{MBR} ;
- Temperature of the Far-Infrared Background Radiation peak T_{FIRB} .

In frames of WUM, we calculate the values of these PCPs, which are in good agreement with the latest results of their measurements.

2.7. Creation of Matter [2]

In 1964, F. Hoyle and J. V. Narlikar offered an explanation for the appearance of new matter by postulating the existence of what they dubbed the "*Creation field*" [21].

In 1974, Paul Dirac discussed continuous creation of matter by additive (uniformly throughout space) and multiplicative mechanism (proportional to the amount of existing matter) [22].

WUM: The 3D World, which is a Hypersphere of 4D Nucleus, was started by a fluctuation in the Eternal Universe. 4D Nucleus is expanding in the fourth spatial dimension, and its surface, the Hypersphere, is likewise expanding. The radius of the Nucleus R is increasing with speed c (gravitodynamic constant) for the absolute cosmological time τ from the Beginning and equals to $R = c\tau$.

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 two-dimensional sphere surface (that has surface energy), we can imagine that the 3D Hypersphere World has a "Surface Energy" of the 4D Nucleus.

The proposed process is 4D process responsible for the expansion, creation of Matter and Arrow of time. It is a 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 Hypersphere World.

2.8. Primary Notions [2]

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 Einstein's field equations have the same form in arbitrary frames of reference.

In **WUM**, this Principle 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. We can use the well-known equations considering time-varying physical parameters.

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 BB model.

In **WUM**, this Principal is valid at the cosmological times $\tau \geq \tau_M$ because Physical Laws are determined by the Medium of the World, which is Homogeneous and Isotropic and consist 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 Principal is not viable for the entire World.

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).

In **WUM,** Conservation Laws are not Exact Conservation Laws because the World is not an isolated physical system and is continuously getting DM from the Eternal Universe.

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

The proposed new Primary Notions are, in fact, a Paradigm Shift for 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. 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 a well-elaborated theory by the entire physical community. Considering the JWST discoveries, successes of WUM, and 86 years of Dirac's ideas, it is high time to make a Paradigm Shift for Cosmology and Classical Physics.

Acknowledgements

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Earth. Review Article

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Abstract

Every year on 22 April, we have celebrated **Earth Day** and the beautiful planet we call home. Earth Day, established in 1970, has been used to highlight our planet's environmental challenges and raise awareness of the importance of protecting our world for future generations [1]. To provide the protection of our planet, we should explain Earth's environmental challenges to the best of our knowledge in frames of contemporary Geophysics.

This paper gives a short overview of the developed Hypersphere World-Universe Model (WUM) and pay particular attention to the principal role of Dark Matter (DM) in the Earth's life. In this manuscript, we discuss different aspects of the Earth: a condition of Early Earth before the Beginning of life on It; Internal Structure; "The 660-km Boundary" that we named Geoplasma; Random Variations of Earth's Rotational Speed on a daily basis; Origin of Moon; Expanding Earth; Internal Heating; Faint Young Sun paradox; Geocorona and Planetary Coronas; High-Energy Atmospheric Physics. WUM proposed principally different way to solve the problems of Internal Heating, Origin of the Moon, and Faint Young Sun paradox based on DM core of the Earth. The Model revealed the fact that the Sun Activity causes the Geoplasma Activity and, as a consequence, Random Variations of Earth's Rotational Speed by the varying Sun's magnetic field.

1. Introduction

About 22 years ago, I developed an interest in Cosmology. For 12 years, I have been elaborating a model I dubbed World-Universe Model (WUM), and then in 2013, I uploaded the first papers on viXra [2], [3], which were, in fact, the beginning of a New Paradigm for Cosmology. From 2015, I published a series of articles on WUM in the "*Journal of High Energy Physics, Gravitation and Cosmology*". The manuscript "*Review Article: Cosmology and Classical Physics*" [4] is a synthesis of my approach to Cosmology and the article "*JWST Discoveries—Confirmation of World-Universe Model Predictions*" [5] is a quintessence of WUM. Results obtained in WUM are quoted in the current work without a full justification; an interested reader is encouraged to view the referenced papers [2]-[12] (and references therein) in such cases.

2. Essence of WUM

Principal Points of WUM are as follows [2]-[12]:

- The Finite World is a 3D Hypersphere of the 4D Nucleus of the World, which is 4D ball expanding in the fourth spatial dimension. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World;
- The Universe is responsible for the creation of Dark Matter (DM) in the 4D Nucleus of the World. Dark Matter Particles (DMPs) carry new DM into the World. Luminous Matter is a byproduct of DMPs self-annihilation. DM plays a central role in creation and evolution of all Macroobjects (MOs);
- WUM introduces Dark Epoch (spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr) and Luminous Epoch (ever since, 13.77 Byr). We emphasize that absolute Age of the World $A_\tau = 14.22\ Byr$ is determined by the experimentally measured value of Gravitational parameter G : $A_\tau \propto G^{-1}$ [6]. Transition from Dark Epoch to Luminous Epoch is due to an Explosive Volcanic Rotational Fission of Overspinning DM Supercluster's Cores (surface speed at equator exceeding escape velocity) and self-annihilation of DMPs;

- The Medium of the World, consisting of protons, electrons, photons, neutrinos, and DMPs [12], is an active agent in all physical phenomena in the World. Time, Space and Gravitation are closely connected with the Impedance, Gravitomagnetic parameter, and Energy density of the Medium, respectively. It follows that neither Time, Space nor Gravitation could be discussed in absence of the Medium. WUM confirms the Supremacy of Matter postulated by A. Einstein: "*When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter*";
- WUM based on Cosmological Time τ that marches on at the constant pace from the Beginning of the World up to the present Epoch along with time-varying Principal Cosmological Parameters;
- 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. Macroobjects' cores are essentially DM Reactors fueled by DMPs. All chemical elements, compositions, substances, rocks, *etc.* are produced by MOs themselves as the result of DMPs self-annihilation in their Cores;
- WUM is the only cosmological model in existence that is consistent with the Fundamental Law of Conservation of Angular Momentum;
- Thanks to the revealed by WUM Inter-Connectivity of Primary Cosmological Parameters, we show that G that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly;
- 3D Finite Boundless World (Hypersphere of 4D Nucleus) presents Patchwork Quilt of main Luminous Superclusters ($\gtrsim 10^3$), which emerged in different places of the World at different Cosmological times. The Medium of the World is Homogeneous and Isotropic. Distribution of MOs is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous. Physical Laws are determined by the Medium;
- WUM is based on two parameters only: dimensionless Rydberg constant α (later named Fine-structure constant) and time-varying Quantity Q that is, in fact, the Dirac Large Number and a measure of the Worlds' curvature in the fourth spatial dimension and the Age of the World. In our opinion, constant α and quantity Q should be named "Universe Constant" and "World Parameter" respectively.
Medium, Multicomponent Dark Matter, and Angular Momentum are Main Pillars of WUM.

3. Early Earth [7]

Formation of Earth. The oldest material found in SS is dated to 4.568 Byr ago [13]. In the article "*The age of the Earth in the twentieth century: a problem (mostly) solved*" G. B. Dalrymple said: *Whether this age represents the age of the Earth's accretion, of core formation, or of the material from which the Earth formed is not yet known, but recent evidence suggests it may approximate the latter* [14].

In **WUM**, DM core of the Earth with a radius of $R_E = 3.52 \times 10^3 \ km$ was born as a result of an Explosive Volcanic Rotational Fission of the Sun's DM Core with the radius of $R_S = 487 \times 10^3 \ km$ 4.57 *Byr* ago [8].

Origin of the Moon is usually explained by a Mars-sized body striking the Earth, making a debris ring that eventually collected into a single natural satellite, the Moon, but there are a number of variations on this giant-impact hypothesis, as well as alternative explanations, and research continues into how the Moon came to be. Other proposed scenarios include captured body, fission, formed together (condensation theory, Synestia), planetesimal collisions (formed from asteroid-like bodies), and collision theories. The standard giant-impact hypothesis suggests that a Mars-sized body, called Theia, impacted the proto-Earth, creating a large debris ring around Earth, which then accreted to form the Moon [15].

Establishing the age of the Moon is critical to understanding solar system evolution and the formation of rocky planets, including Earth. However, despite its importance, the age of the Moon has never been accurately determined. M. Barboni, *et al.* "*present uranium-lead dating of Apollo 14 zircon fragments that yield highly precise, concordant ages, demonstrating that they are robust against post crystallization isotopic*

disturbances. Hafnium isotopic analyses of the same fragments show extremely low **initial $^{176}Hf/^{177}Hf$ ratios** *corrected for cosmic ray exposure that are near the solar system initial value. Our data indicate differentiation of the lunar crust by 4.51 billion years, indicating the formation of the Moon within the first ∼60 million years after the birth of the solar system"* [16].

Following the prevailing giant-impact hypothesis, planetary geophysicists at the German Aerospace Center, led by M. Maurice, have used a new **numerical model** to reconstruct the time at which the event occurred. They report that the Moon formed 4.425 ±0.025 billion years ago, and that it hosted an **ocean of magma** for substantially longer time than previously thought (for ∼200 million years) [17].

In **WUM**, DM core of the Moon with the radius of $R_M = 0.381 \times 10^3 \ km$ was born as the result of the Explosive Volcanic Rotational Fission of the Earth's DM Core $\lesssim 4.57 \ Byr$ [7].

Continental crust of Earth. The long-favored paradigm for the development of continental crust is one of progressive growth beginning at ∼4 billion years ago. To test this hypothesis, T. M. Harrison, *et al.* measured **$^{176}Hf/^{177}Hf$ values** of $4.01 - 4.37 \ Gyr$ detrital zircons from Western Australia and obtained results that support the view that crust had formed by $4.4 - 4.5 \ Gyr$ and was rapidly recycled into the mantle [18].

Earth's Atmosphere and Oceans were formed by volcanic activity and outgassing. Most of the gas was carbon dioxide and water vapor that condensed into oceans. In this model, atmospheric greenhouse gases kept the oceans from freezing when the newly forming Sun had only 70% of its current luminosity.

According to a "Lumen Learning. Earth Science" [19]: *Scientists have developed a number of hypotheses about how the oceans formed. Though these hypotheses have changed over time, one idea now has the wide support of Earth scientists, called the volcanic outgassing theory. This means that water vapor given off by volcanoes erupting over millions or billions of years, cooled and condensed to form Earth's oceans.*

According to the "National Ocean Service" [20]: *Most scientists agree that the atmosphere and the ocean accumulated gradually over millions and millions of years with the continual 'degassing' of the Earth's interior. According to this theory, the ocean formed from the escape of water vapor and other gases from the molten rocks of the Earth to the atmosphere surrounding the cooling planet. After the Earth's surface had cooled to a temperature below the boiling point of water, rain began to fall—and continued to fall for centuries. As the water drained into the great hollows in the Earth's surface, the primeval ocean came into existence. The forces of gravity prevented the water from leaving the planet.*

In the paper "Uncovering Mysteries of Earth's Primeval Atmosphere 4.5 Billion Years Ago and the Emergence of Life" ETH Zurich (a leading scientist P. Sossi) wrote [21]: *Four-and-a-half billion years ago, Earth would have been hard to recognize. Instead of the forests, mountains, and oceans that we know today, the surface of our planet was covered entirely by* **magma** *– the molten rocky material that emerges when* **volcanoes erupt***. This much the scientific community agrees on. What is less clear is what the atmosphere at the time was like.*

In the paper "Redox state of Earth's magma ocean and its Venus-like early atmosphere" [22], P. A. Sossi, *et al.* found that *after cooling down from the magma state, the young Earth had an atmosphere that was slightly oxidizing, with carbon dioxide as its main constituent, as well as nitrogen and some water. The surface pressure was also much higher, almost one hundred times that of today and the temperature was much higher, due to the hot surface. These characteristics made it more similar to the atmosphere of today's Venus than to that of today's Earth.* Based on their results, the authors made a conclusion that a *popular theory on the emergence of life on Earth, in which lightning strikes interact with certain gases (notably ammonia and methane) to create amino acids – the building blocks of life – seems much less likely. The necessary gases were simply not sufficiently abundant.*

Origin of Life. M. Dodd, *et al.* in the article "Evidence for early life in Earth's oldest hydrothermal vent precipitates" wrote [23]: *Although it is not known when or where life on Earth began, some of the earliest habitable environments may have been submarine-hydrothermal vents. Here we describe putative fossilized microorganisms that are at least 3,770 million and possibly 4,280 million years old in ferruginous sedimentary rocks, interpreted as **seafloor-hydrothermal vent-related precipitates**. These structures occur as micrometre-scale haematite tubes and filaments with morphologies and mineral assemblages similar to those of filamentous microorganisms from modern hydrothermal vent precipitates and analogous microfossils in younger rocks. Collectively, these observations are consistent with an oxidized biomass and provide evidence for biological activity in submarine-hydrothermal environments more than 3,770 million years ago* [21].

The proposed concept of **Dark Matter Reactors** in Cores of all gravitationally-rounded Macroobjects successfully explains all these hypothesis and results for the Early Earth [7]:

- The Upper mantle with Crust are due to the DM core volcanic activity of the "homemade" compositions (including magma), which produced as the result of the self-annihilation of DMPs in the DM core. It explains the result that continental crust had formed by $4.4 - 4.5 \, Gyr$;
- Earth's Atmosphere and Oceans were formed by the volcanic activity and outgassing of DM core;
- The thickness of the Upper mantle with Crust is growing in time: the Early Earth had a smaller thickness than it is in the present time. Hence, the temperature of the Earth's surface was higher than its calculated temperature based on the Sun's output at that time. It kept the oceans from freezing when the newly forming Sun had only 70% of its current luminosity;
- The *biological activity in submarine-hydrothermal environments more than 3,770 million years ago* can be explained by a generation of all kinds of chemical elements and compositions produced into the Earth's DM core.

4. Present Earth [9]
4.1. Internal Structure

Information about the Earth's structure mostly comes from the analysis of seismic waves. According to the standard model, the Earth has the following layers: an outer silicate solid Crust, solid Mantle, a liquid Outer core, and a solid Inner core. The Inner core is believed to be composed of an iron–nickel alloy with some other elements. The temperature at the Inner core's surface is estimated to be approximately 5,700 K. The liquid Outer core surrounds the Inner core and is believed to be composed of iron mixed with nickel and trace amounts of lighter elements.

Although seismic waves propagate through the core as if it was solid measurements cannot distinguish between a perfectly solid material from an extremely viscous one. Some scientists have therefore considered whether there may be **slow convection in the Inner Core as is believed to exist in the Mantle.** That could be an explanation for the anisotropy detected in seismic studies. In 2009, B. Buffett estimated the viscosity of the Inner core at 10^{18} kg $m^{-1} \, s^{-1}$ [24].

In our view, the Inner core, Outer core, and Lower mantle are the parts of the Earth's liquid DM core, which have different viscosities from extremely high values for the Inner core going down to a 660-km boundary between the Lower mantle and Upper mantle with Crust (see Section 4.2). The main characteristics of the Earth's layers are presented in **Table 1**.

Table 1. Density and Mass of Earth's Layers. Adapted from [25].

Depth, km	Component Layer	Outer Radius, Rel. to Earth Radius	Density, kg/m^3 $\times 10^3$	Mass, kg $\times 10^{22}$	Mass, Rel. to Earth Mass
0	Atmosphere		0.0012	0.0005	0.0000008
0 - 11	Oceans	1	1.02 – 1.05	0.14	0.0002
0 - 35	Crust	1	2.2 – 2.9	4	0.007
35 - 660	Upper Mantle	0.99	3.4 – 4.4	112	0.19
660 - 2900	Lower Mantle	0.9	3.4 – 5.6	265	0.44
2900 - 5100	Outer Core	0.55	9.9 – 12.2	183	0.31
5100 - 6400	Inner Core	0.2	12.8 – 13.1	12	0.02

Let us take a look at the structure of the Earth:

- An Inner core and an Outer core that extend from the Centre to about 55% of the Earth radius with density $\rho_{max} = 13 \times 10^3 \ kg/m^3$ and $\rho_{min} = 9.9 \times 10^3 \ kg/m^3$;
- Lower mantle, spanning from the Outer core to about 90% of the Earth radius (below 660 km) with density $\rho_{max} = 5.6 \times 10^3 \ kg/m^3$ and $\rho_{min} = 3.4 \times 10^3 \ kg/m^3$;
- Upper mantle, spanning from the Lower mantle to about 99% of the Earth radius (below 35 km) with density $\rho_{max} = 4.4 \times 10^3 \ kg/m^3$ and $\rho_{min} = 3.4 \times 10^3 \ kg/m^3$;
- Inner core, Outer core, and Lower mantle contain most of the Earth's mass [26].

4.2. The 660-km Boundary. Geoplasma

Very little is known about the Lower mantle apart from that there is a seismicity cutoff-660 (660-km discontinuity): $\rho_{min} = 3.4 \times 10^3 \ kg/m^3$ for the Lower mantle is less than $\rho_{max} = 4.4 \times 10^3 \ kg/m^3$ for the Upper mantle. In our view, Lower mantle is the part of the Earth's DM core.

W. Wu, S. Ni, and J. Irving investigated scattered seismic waves traveling inside the Earth to constrain the roughness of the Earth's 660-km boundary [27]. The researchers were surprised by just how rough that boundary is – rougher than the surface layer that we all live on. Their statistical model didn't allow for precise height determinations, but there's a chance that these mountains are bigger than anything on the surface of the Earth. The roughness was not equally distributed, either; just as the Crust's surface has smooth ocean floors and massive mountains, the 660-km boundary has rough areas and smooth patches [28]. Lacking a formal name for this layer, the researchers simply call it "*the 660-km boundary.*"

X. Markenscoff in the paper "*"Volume collapse" instabilities in deep-focus earthquakes: a shear source nucleated and driven by pressure*" explains "*the mystery of the long-standing observations in deep-focus earthquakes (400-700 km) by symmetry-breaking instabilities in high-pressure phase transformation, which produce the counterintuitive phenomenon of "volume collapse" producing only shear radiation, with little, or no, volumetric component, even under conditions of full isotropy*" [29].

According to **WUM**, the 660-km boundary is a boundary between Earth's DM core and Upper mantle with Crust, which were produced by DM core during 4.57 billion years [9]. The deep-focus earthquakes are connected with random mass ejections happening at the 660-km boundary as the result of DMPs self-annihilation in the DM core.

In our opinion, all chemical elements, compositions, substances of the Earth including protons, electrons, multicharged ions, isotopes K-40, U-238, Th-232, Pu-244 (see Section 4.4), are produced within DM Reactor (DMR) inside of the Earth as the result of DMPs self-annihilation. They concentrate in "the 660-km boundary" and arrive in the Crust of the Earth due to convection currents in the mantle carrying heat and all chemical products from the interior to the planet's surface [30]. In our view, "the 660-km boundary" is "Geoplasma", electrical currents of which define the Earth's magnetic field. Its random mass ejections are responsible for random variations of the Earth's rotational speed on a daily basis (see Section 4.3).

4.3. Random Variations of Earth's Rotational Speed

G. Jones and K. Bikos in the paper "Earth Is in a Hurry in 2020" wrote [31]:

When highly accurate atomic clocks were developed, they showed that the length of a mean solar day can vary by milliseconds. These differences are obtained by measuring the Earth's rotation with respect to distant astronomical objects". It turned out that the variations of the daylength throughout 2020 were in the range $86400^{+1.62ms}_{-1.46ms}$ s . *The speed of the Earth's rotation varies constantly because of the complex motion of its molten core, oceans and atmosphere, plus other effects* (see **Figure 1**, **Figure 2**, and **Figure 3**).
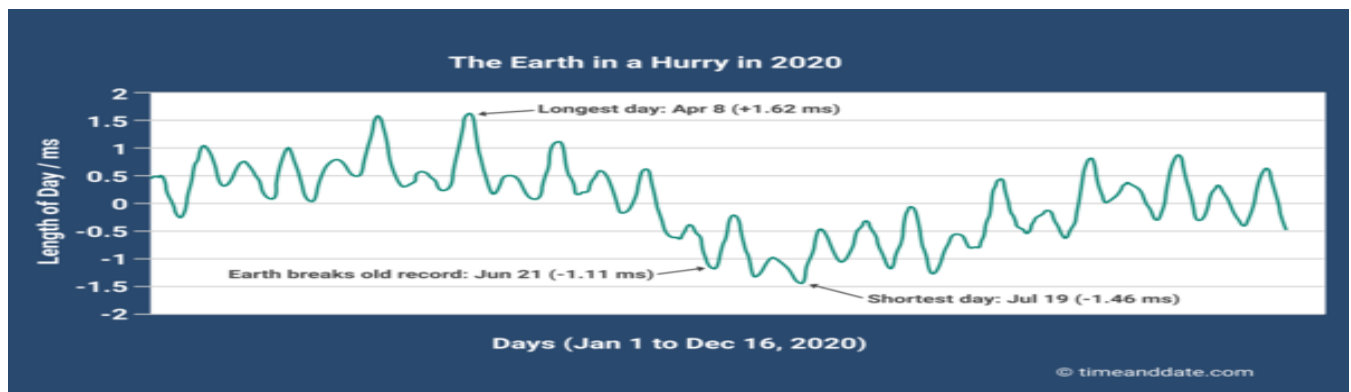

Figure 1. Variation of daylength throughout 2020. The length of day is shown as the difference in milliseconds (ms) between the Earth's rotation and 86,400 seconds. Adapted from [31].

In frames of WUM, **random variations of the Earth's rotational speed on a daily basis** can be explained by variations in the activity of the Earth's DMR and the 660-km layer that we named Geoplasma. As the result of DMPs self-annihilation, **random mass ejections** are happening. During a time of high DMR activity, the Earth's rotational speed is lower (long days) due to increase of the Earth's moment of inertia. When **random mass ejections** are less frequent, the Earth's moment of inertia is decreasing, we observe short days [8].
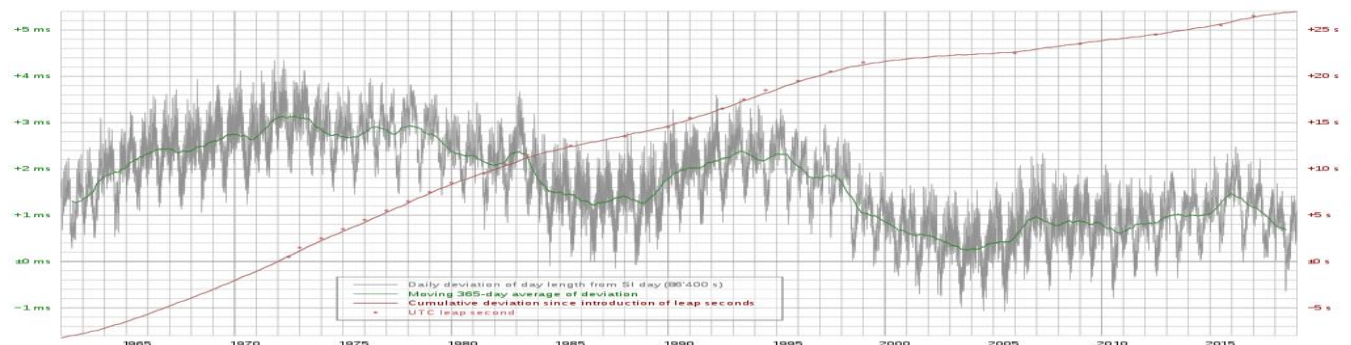

Figure 2. Deviation of day length from SI based day since 1962 to 2019. Adapted from [32]
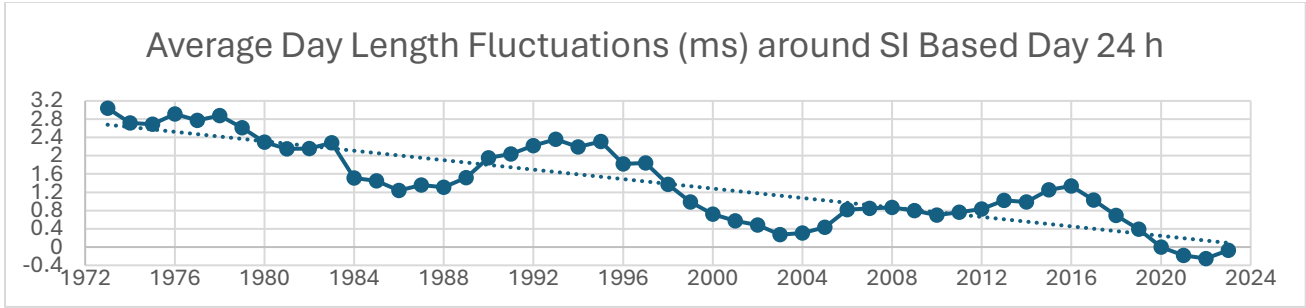
Figure 3. Deviation of average day length from SI based day since 1973 to 2023. Adapted from [33]

Let us analyze the proposed mechanism. The relative change of the daylength throughout 2020 was about 2×10^{-8} . Hence, the relative change of the Earth's moment of inertia must be about 2×10^{-8} . If a layer of a mass m at radius of r will shift on h , the relative change of the Earth's moment of inertia will be about $\frac{m}{M}\frac{r}{R}\frac{h}{R}\sim 10^{-8}$, where M and R are the mass and radius of the Earth, respectively. In case of the Atmosphere (see **Table 1**): $\frac{m}{M} \sim 10^{-6}$, $r \sim R$, and $\frac{h}{R} \sim 10^{-2}$. It means that $h \sim 64\ km$. In case of the Oceans: $\frac{m}{M} \sim 10^{-4}$, $r \sim R$, and $\frac{h}{R} \sim 10^{-4}$. It means that $h \sim 640\ m$. In case of the Geoplasma (boundary Lower mantle – Upper mantle) : $\frac{m}{M} \sim 10^{-5}$, $r \sim R$, and $\frac{h}{R} \sim 10^{-3}$. It means that $h \sim 6.4\ km$.

The estimated values of the masses and shifts show:

- There is no way to explain the random variations of the speed of the Earth's rotation by the complex motion of oceans and atmosphere as it was supposed in [31];
- They can be explained by random mass ejections in the Geoplasma;
- It is worth noting that since 1973 to 2023 (see **Figure 3**), the averaged deviation of the average day length dropped down from 2.7 ms to 0.1 ms;
- The maximum activity of DMR and Geoplasma and maximum of the average day lengths were observed at 2016, 2006, 1994, 1983, and 1972 (see **Figure 2**), which are about 11 years apart.

It is interesting that the full solar cycle is actually a 22-year phenomenon. The sunspot cycle happens because of this pole flip — north becomes south and south becomes north—approximately every 11 years. Some 11 years later, the poles reverse again back to where they started. **The sun behaves similarly over the course of each 11-year cycle** no matter which pole is on top, however, so this shorter cycle tends to receive more attention (see **Figure 4**).

Consider that the last minimum Sunspot number was at 2010 and the next one was at 2021. Hence, the next maximum Sunspot number was at 2016 that corresponds to the maximum of the average day length. It means that the maximum Sun activity causes the maximum Geoplasma activity!
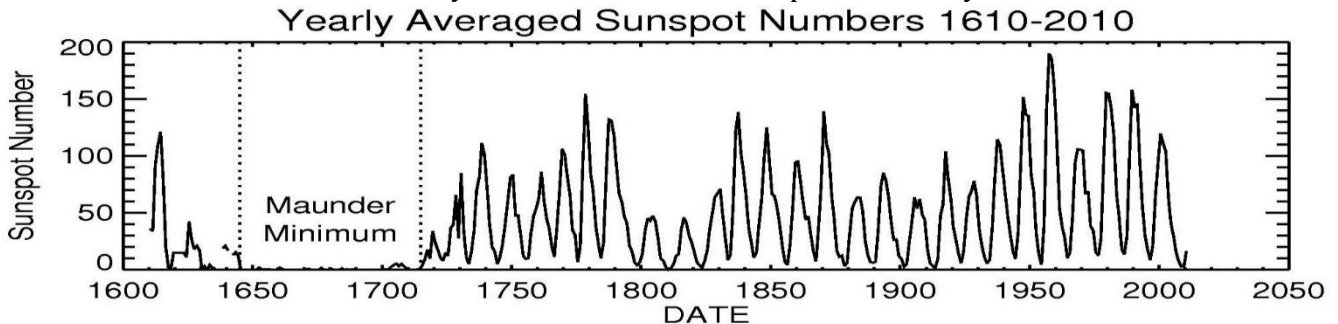

Figure 4. The yearly averaged sunspot number for a period of 400 years (1610-2010). SOURCE: Courtesy of NASA Marshall Space Flight Center. Adapted from [34].

By analyzing the minute changes in travel times and wave shapes for earthquake doublets, the authors article [35] concluded that the Earth's inner core is rotating faster than its surface by about 0.3-0.5 degrees per year. Researches article [36] found that *Earth's inner core, made up of solid iron, 'superrotates' in an eastward direction -- meaning it spins faster than the rest of the planet -- while the outer core, comprising mainly molten iron, spins westwards at a slower pace*.

The fact that Macroobject Cores rotate faster than surrounding envelopes, despite high viscosity of the internal medium, is intriguing. WUM explains this phenomenon through absorption of DMPs by Cores. DMPs supply additional angular momentum ($\propto \tau^2$). Hence, a relative additional Earth's angular momentum for $\Delta t = 50\ yr$ is $\Delta L_E / L_E = 2\Delta t / A_E = 100/4.6 \times 10^9 = 2.2 \times 10^{-8}$, where A_E is the Earth's age. It means that the average length of the day will be shorter by $2.2 \times 10^{-8} \times 86400 = 1.9\ ms$, which is in good agreement with experimentally observed $2.6\ ms$ (see **Figure 3**). This result confirms the existence of Geoplasma.

4.4. Sun

Let us take a look at the internal structure of the Sun [37]:

- Core that extends from the center to about 20–25% of the solar radius, contains 34% of the Sun's mass with density $\rho_{max} = 1.5 \times 10^5\ kg/m^3$ and $\rho_{min} = 2 \times 10^4\ kg/m^3$. It produces all of Sun's energy;
- Radiative zone from the Core to about 70% of the solar radius with density $\rho_{max} = 2 \times 10^4\ kg/m^3$ and $\rho_{min} = 2 \times 10^2\ kg/m^3$ in which energy transfer occurs by means of radiation;
- Core and Radiative zone contain practically all Sun's mass [38];
- Convection zone extends from 0.7 solar radii (500,000 km) to near the surface. The solar plasma is not dense enough or hot enough to transfer the heat energy of the interior outward via radiation;
- The visible surface of the Sun, the photosphere, is the layer below which the Sun becomes opaque to visible light.

The radiative zone and the convective zone are separated by a transition layer, the **tachocline**. This is a region where the sharp regime change between the uniform rotation of the radiative zone and the differential rotation of the convection zone results in a large shear between the two—a condition where successive horizontal layers slide past one another. Presently, it is hypothesized that a magnetic dynamo within this layer generates the Sun's magnetic field.

According to **WUM**, Core and Radiative zone are parts of DM Core of the Sun. The tachocline is an analog of Geoplasma introduced for the Earth. It consists of all chemical elements, compositions of the Sun including protons, electrons, multicharged ions, which are produced within the Sun's DM Reactor as the result of DMPs self-annihilation. We can name it "Solarplasma", electrical currents of which define the Sun's magnetic field.

It is worth noting that the large power output of the Sun is mainly due to the huge size and density of its Core (compared to the Earth), with only a fairly small amount of power being generated per cubic meter. Theoretical models of the Sun's interior indicate a maximum power density of approximately $276.5\ W/m^3$ at the center of the Core [39], which is about the same power density inside a compost pile [40] and closer approximates reptile metabolism than a thermonuclear bomb.

The existence of the Sun's DM Core follows from results obtained by E. Fossat, *et al.* who found that Solar Core rotates 3.8 ± 0.1 faster than the surrounding envelope [41]. The fact that the Solar Core rotates faster than surrounding envelope, despite high viscosity of the internal medium, is intriguing. WUM explains this phenomenon through the absorption of DMPs by Solar Core over time τ . DMPs supply not only additional mass ($\propto \tau^{3/2}$), but also additional angular momentum ($\propto \tau^2$). DM Core irradiates products of DMPs self-annihilation, which carry away excessive angular momentum. Solar Wind is the result of this mechanism [8].

In our view, **all gravitationally-rounded Macroobjects have the same internal structure.**

4.5. Origin of Moon

Lunar origin fission hypothesis was proposed by George 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 [42]. Donald U. Wise made a detailed analysis of this hypothesis in 1966 and concluded that "*it might seem prudent to include some modified form of rotational fission among our working hypothesis*" [43].

At present time, a rotational angular momentum of the Earth L_{rot}^E is substantially smaller than Moon's orbital momentum L_{orb}^M. In the article "*Solar System. Angular Momentum. New Physics*" [9], we performed a detailed analysis of the rotational angular momentum of the overspinning DM core of the Earth L_{rot}^{DME} and found that $L_{rot}^{DME} = 2.2 \times L_{orb}^M$ at the Beginning of the Solar System. It means that the Moon could be created by the overspinning DM core of the Earth as the result of Its Explosive Volcanic Rotational Fission.

In our opinion, lower mantle is a part of the Earth's DM core. It could be significantly different 4.57 Byr ago. During this time it was gradually filled with all chemical elements produced by the Earth's DM core due to DM particles DMF1 (1.3 TeV) self-annihilation [12].

4.6. Expanding Earth

Expanding Earth hypothesis asserts that the position and relative movement of continents is at least partially due to the volume of the Earth increasing. In 1888, I. O. Yarkovsky suggested that some sort of aether is absorbed within Earth and transformed into new chemical elements, forcing the celestial bodies to expand. The theses of O. C. Hilgenberg (1933) and N. Tesla (1935) were based on absorption and transformation of aether-energy into normal matter. In spite of the recognition of plate tectonics in the 1970s, scientific consensus has rejected any significant expansion or contraction of the Earth [44].

In **WUM**, the Earth's DM core absorbs new DMPs, and its size is increasing in time $\propto \tau^{1/2}$. There is an expansion of DM core, and hence, the Upper mantle with Crust is stretching out. Due to DMPs self-annihilation, new chemical elements are created inside of the Upper mantle with Crust. As a result, the relative movement of continents is happening. The Medium of the World with DMPs are, in fact, some sort of aether proposed by Yarkovsky, Hilgenberg, and Tesla.

4.7. Internal Heating

The analysis of the Sun's heat for planets in SS yields the effective temperature of the Earth of 255 K [45]. The actual mean surface temperature of Earth is 288 K [46]. The higher actual temperature of the Earth is due to the heat generated internally by the planet itself. According to the standard model, the Earth's internal heat is produced mostly through radioactive decay. The major heat-producing isotopes within the Earth are K-40, U-238, and Th-232. The mean global heat loss from Earth is 44.2 $\pm$ 1.0 TW [47]. The Earth's Uranium has been thought to be produced in one or more supernovae over 6 Byr ago.

Radiogenic decay can be estimated from the flux of geoneutrinos that are emitted during radioactive decay. The KamLAND Collaboration combined precise measurements of the geoneutrino flux from the Kamioka Liquid-Scintillator Antineutrino Detector, Japan, with existing measurements from the Borexino detector, Italy. They found that decay of U-238 and Th-232 together contribute about 20 TW to the total heat flux from the Earth to space. The neutrinos emitted from the decay of K-40 contribute 4 TW. Based on the observations the KamLAND Collaboration made a conclusion that *"heat from radioactive decay contributes about half of Earth's total heat flux"* [48].

Plutonium-244 with half-life of 80 million years is not produced in significant quantities by the nuclear

fuel cycle because it needs very high neutron flux environments. Any Pu-244 present in the Earth's Crust should have decayed by now. Nevertheless, D. C. Hoffman, *et al.* in 1971 obtained the first indication of Pu-244 present existence in Nature [49].

In **WUM**, all chemical products of the Earth including isotopes K-40, U-238, Th-232, and Pu-244, are produced by Dark Matter Reactor inside of the Earth during 4.57 billion years and are, in fact, "Homemade". They are a result of the DMPs self-annihilation with the rest energy 1.3 TeV (compared to proton rest energy 938 MeV). The products arrive in the Crust of the Earth due to convection currents in the mantle carrying heat and isotopes from the interior to the planet's surface [30].

As a conclusion, the internal heating of all gravitationally-rounded Macroobjects of SS is due to DMPs self-annihilation in their DM cores made up of DMPs (1.3 TeV). The amount of energy produced due to this process is sufficiently high to heat up the Macroobjects. New DMPs freely penetrate through the entire Macroobjects' envelope, get absorbed into the DM cores, and continuously support DMPs self-annihilation.

4.8. Faint Young Sun paradox

"Faint young Sun" paradox describes the apparent contradiction between observations of liquid water early in Earth's history and the astrophysical expectation that the Suns' output would be only 70 percent as intense during that epoch as it is during the modern epoch. The early Earth would be expected to be completely frozen, but the early Earth seems to have had liquid water. The issue was raised by astronomers C. Sagan and G. Mullen in 1972 [50]. An unresolved question is how a climate suitable for life was maintained on Earth over the long timescale despite the variable solar output and wide range of terrestrial conditions [51]. Proposed resolutions of this paradox have taken into account greenhouse effects, changes to planetary albedo, astrophysical influences, or combinations of these suggestions.

One of the consequences of **WUM** holds that all stars were fainter in the past. As their cores absorb new DM, size of macroobjects cores R_{MO} and their luminosity L_{MO} are increasing in time $R_{MO} \propto \tau^{1/2}$ and $L_{MO} \propto \tau$ respectively. Taking 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 Suns' output was 67% of what it is today. Literature commonly refers to the value of 70% [52].

In frames of WUM, the Upper mantle with Crust are due to DM core activity: the self-annihilation of DMPs in the DM core. As a result of this activity, the thickness of the Upper mantle with Crust is growing in time: the early Earth had a smaller thickness than it is in the present time. Hence, the temperature of the Earth's surface was higher than its calculated temperature based on the Sun's output at that time.

4.9. Geocorona and Planetary Coronas [10]

The geocorona is the luminous part of the outermost region of the Earth's atmosphere that extends to at least 640,000 km from the Earth [53]. It is seen primarily via far-ultraviolet light (Lyman-alpha) from the Sun that is scattered by neutral hydrogen.

Far-ultraviolet photons in Geocorona have been observed out to a distance of approximately 100,000 km from the Earth [54]. The first high-quality and wide-field-of-view image of Earth's corona of 243,000 km was obtained by Hisaki, the first interplanetary micro-spacecraft [55]. Hisaki acquires spectral images (52-148 nm) of the atmospheres of planets from Earth orbit and has provided quasi-continuous remote sensing observations of the geocorona since 2013 [56]. The most popular explanation of this geocoronal emission is the scattering of Solar Far-Ultraviolet (FUV) photons by exospheric hydrogen.

X-rays from Earth's geocorona were first detected by Chandra X-ray Observatory in 1999 [57]. X-rays were observed in the range of energies $0.08 - 10 \, keV$ [55]. The main mechanism explaining geocoronal X-rays is that they are caused by collisions between neutral atoms in the geocorona with carbon, oxygen and

nitrogen ions that are streaming away from the Sun in the solar wind [57], [58], [59]. This process is called "charge exchange" since an electron is exchanged between neutral atoms in geocorona and ions in solar wind.

X-rays from Planets were also observed by Chandra [57]. According to NASA:

- The X-rays from Venus and, to some extent, the Earth, are due to the fluorescence of solar X-rays striking the atmosphere;
- Fluorescent X-rays from oxygen atoms in the Martian atmosphere probe heights similar to those on Venus. A huge Martian dust storm was in progress when the Chandra observations were made. The intensity of the X-rays did not change during the dust storm;
- Jupiter has an environment capable of producing X-rays in a different manner because of its substantial magnetic field. X-rays are produced when high-energy particles from the Sun get trapped in its magnetic field and accelerated toward the polar regions where they collide with atoms in Jupiter's atmosphere;
- Like Jupiter, Saturn has a strong magnetic field, so it was expected that Saturn would also show a concentration of X-rays toward the poles. However, Chandra's observation revealed instead an increased X-ray brightness in the equatorial region. Furthermore, Saturn's X-ray spectrum was found to be similar to that of X-rays from the Sun.

In **WUM**, the Geocorona is a stable Shell around the Earth with inner radius $R_{in} \cong 6.5 \times 10^6 \ m$ and observed outer radius $R_{out} \cong 6.4 \times 10^8 \ m$. The total mass of this Shell $\cong 4.1 \times 10^{18} \ kg$.

In our opinion, described picture of Geo and Planetary Coronas is similar to the picture of Solar Corona:

- At the distance of 243,000 km from the Earth, atoms and molecules are so far apart that they can travel hundreds of kilometers without colliding with one another. Thus, the exosphere no longer behaves like a gas, and the particles constantly escape into space. In our view, FUV radiation and X-rays are the consequence of DMF3 (3.7 keV) self-annihilation [12];
- All planets and some observed satellites (Europa, Io, Io Plasma Torus, Titan) have X-rays in upper atmosphere of the planets, similar to the Solar Corona;
- The calculated density of the Earth's fractal structure $\rho_f \cong 2.5 \times 10^{-7} \ kg/m^3$ is in good agreement with experimental results for atmosphere density at the lowest temperature (below -143 °C) at 100 km altitude, similar to that of the Solar Corona;

According to **WUM**, the characteristics of Geocorona are similar to characteristics of Solar Corona:

- The Geocorona made up of DMPs resembles a honeycomb filled with plasma including the ionosphere from about 60 km to 1,000 km altitude;
- The Geocorona is a stable Shell around the Earth with inner radius $R_{in} \cong 6.4 \times 10^6 \ m$ and observed outer radius $R_{out} \cong 6.4 \times 10^8 \ m$. The total mass of this Shell $\cong 4.1 \times 10^{18} \ kg$;
- At the distance of 640,000 km from the Earth, atoms and molecules are so far apart that the outermost region of the Earth's atmosphere no longer behaves like a gas;
- X-rays and gamma-rays are the consequence of DMPs self-annihilation;
- X-rays and gamma-rays are going not only up and out of the Earth, but also down to the Earth's surface;
- In case the source altitudes of the gamma rays is below about 20 km (within the altitude range of thunderstorms), they can reach the surface of the Earth (see Section 4.9).

4.10. High-Energy Atmospheric Physics [11]

Lightning initiation problem. Years of balloon, aircraft, and rocket observations have never found large enough electric fields inside thunderstorms to make a spark. And yet lightning strikes the Earth about 4 million times per day. This has led to the cosmic-ray model of lightning initiation [60], [61].

Terrestrial Gamma-Ray Flashes (TGFs) were first detected by chance by NASA's Earth-orbiting Compton gamma ray telescope. Compton was searching for GRBs from exploding stars, when it unexpectedly began detecting very strong bursts of high energy x-rays and gamma rays, coming from Earth [57].

There are two leading models of TGF formation: Lightning leader emission and Dark Lightning [60], but they still do not account for:

- A bright TGF observed by a spacecraft in the middle of Sahara Desert on a nice day. The nearest thunderstorms were ~ 1000 miles away [62];
- An ultraviolet telescope installed on the Russian satellite has registered several powerful explosions of light in the Earth's atmosphere at an altitude of several dozen kilometers in clear weather [63].

Additionally, in frames of existing models it is difficult to explain the following results [11]:

- Unusual surges of radiation at 511 keV when there were no thunderstorms;
- Beams of antimatter (positrons) produced above thunderstorms on Earth;
- TGF coming down from the overhead thundercloud;
- Some lightnings produce X-rays and others do not;
- Explosive production of energetic particles observed from space;
- The spectra of TGFs at very high energies (40–100 MeV).

According to **WUM**, the characteristics of Geocorona are similar to the characteristics of the Solar Corona. As the result of a large fluctuation of DMPs in Geocorona and their self-annihilation, X-rays and gamma-rays are going not only up and out of the Earth, but also down to the Earth's surface. In our view, TGFs are, in fact, well-known Gamma Ray Bursts. The spectra of TGFs at very high energies can be explained by DMF1 (1.3 TeV) and DMF2 (9.6 GeV) self-annihilation [12]. Lightning initiation problem can be solved by X-rays and gamma-rays, which slam into the thunderclouds and carve a conductive path through a thunderstorm. From this point of view, it is easy to explain all experimental results summarized above.

Conclusion

ALLATRA International Public Movement was founded in 2011 on the basis of Lagoda International Public Organization. Today, participants of the movement are implementing a vast number of large-scale projects in different areas. The projects are being accomplished by the world's best volunteer experts from various walks of life who are not indifferent to the future of our civilization and who develop their professional and creative potential for the benefit of the whole humanity [64].

Dr. Egon Cholakian, a distinguished scientist renowned for his work in climate research and national security, has directly addressed world leaders Mr. Joe Biden, Mr. Xi Jinping, and Mr. Vladimir Putin, highlighting the gravity of the ongoing destructive climate events that threaten the future of our planet and humanity. He said "*This is a matter of supranational security and a matter that affects every country and every individual citizen*" [65].

We hope that our Model, which explains Earth's environmental challenges to the best of our knowledge today, will help ALLATRA to analyze their experimental results through the prism of WUM, perform new targeted experiments, and make reliable forecast for the future of our Home-planet.

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Cosmic Bubbles

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Abstract

The present paper is inspired by the article "Ho'oleilana: An Individual Baryon Acoustic Oscillation?" published by R. B. Tully, C. Howlett, and D. Pomarède on Sep. 2023 [1]. They claim: *Evidence is presented here for the discovery of a remarkably strong individual contribution to the baryon acoustic oscillation (BAO) signal at z = 0.068, an entity that is given the name Ho'oleilana.*

K. Dawson, co-spokesperson for Dark Energy Spectroscopic Instrument *is more inclined to believe that this latest finding is something of a coincidence, a chance alignment that simply looks like a sphere with a radius around what you'd expect for a BAO* [2].

In the paper, we provide a short summary of experimental observations of Boötes Void and Superclusters; discuss the main features of the developed Hypersphere World-Universe Model; introduce notions "Cosmic Voids" and "Cosmic Bubbles"; elaborate a mathematical framework for different types of Cosmic Bubbles (Hubble Spherical Bubble for the World, Disk Bubbles for Galaxies; Spherical Bubbles for Extrasolar Systems, Dark Matter (DM) Spherical Bubbles for Galaxies and Superclusters); make a conclusion that the Boötes is a DM Cosmic Bubble and suggest experiments, which confirm our conclusion.

1. Introduction

In the article "Ho'oleilana: An Individual Baryon Acoustic Oscillation?" [1], R. B. Tully, C. Howlett, and D. Pomarède claim: *Evidence is presented here for the discovery of a remarkably strong individual contribution to the baryon acoustic oscillation (BAO) signal at z = 0.068, an entity that is given the name Ho'oleilana. The radius of the 3D structure is* $155h_{75}^{-1}$ *Mpc. At its core is the Boötes supercluster. The Sloan Great Wall, CfA Great Wall, and Hercules complex all lie within the BAO shell. The interpretation of Ho'oleilana as BAO structure with our preferred analysis implies a value of the Hubble constant of* $76.9_{-4.8}^{+8.2}$ $kms^{-1}Mpc^{-1}$.

The authors summarize their results: *Significance of the detection of Ho'oleilana, **its shape**, its relation to other previously known structures in the local Universe, and the prominence of the feature compared to the expectations of both a random field of galaxies and simulations with large-scale structure but suppressed BAO, strongly suggest Ho'oleilana is itself a part of the BAO feature rather than a chance alignment.* BAO stands for "baryon acoustic oscillation," a sort of frozen sound wave created by processes near the dawn of time (see **Figure 1**).

A. Mann in the article "Ho'oleilana, a Billion-Light-Year-Wide Bubble of Galaxies, Astounds Astronomers" [2] wrote: *According to theoretical predictions, that formation is not quite the right size to be a BAO. This discrepancy could either imply that conditions in the early universe weren't quite what astronomers have expected or that the structure is a chance alignment of galaxies masquerading as a BAO. Tully and Pomarède think their discovery could be used to probe fundamental properties of the cosmos. But in order to do so, they need to convince the rest of the community that the result is what they believe it to be.*

The size of any individual BAO is set by the speed of sound in the early universe's primordial plasma, which was roughly half the speed of light. This created pressure waves with particular amplitudes, which were stretched out by later cosmic expansion to a bit less than half a billion light-years. But Ho'oleilana's radius is actually about 10 percent greater than would be expected with such processes. To Tully and his colleagues, this could indicate something important about the nascent universe.

Of course, the aberrant size of the team's BAO could also lead to other conclusions. The outlines of the billionish-light-year bubbles are extremely faint and only become apparent when one examines an enormous number of objects over great distances, says K. Dawson. He's more inclined to believe that this latest finding is something of a coincidence, a chance alignment that simply looks like a sphere with a radius around what you'd expect for a BAO.
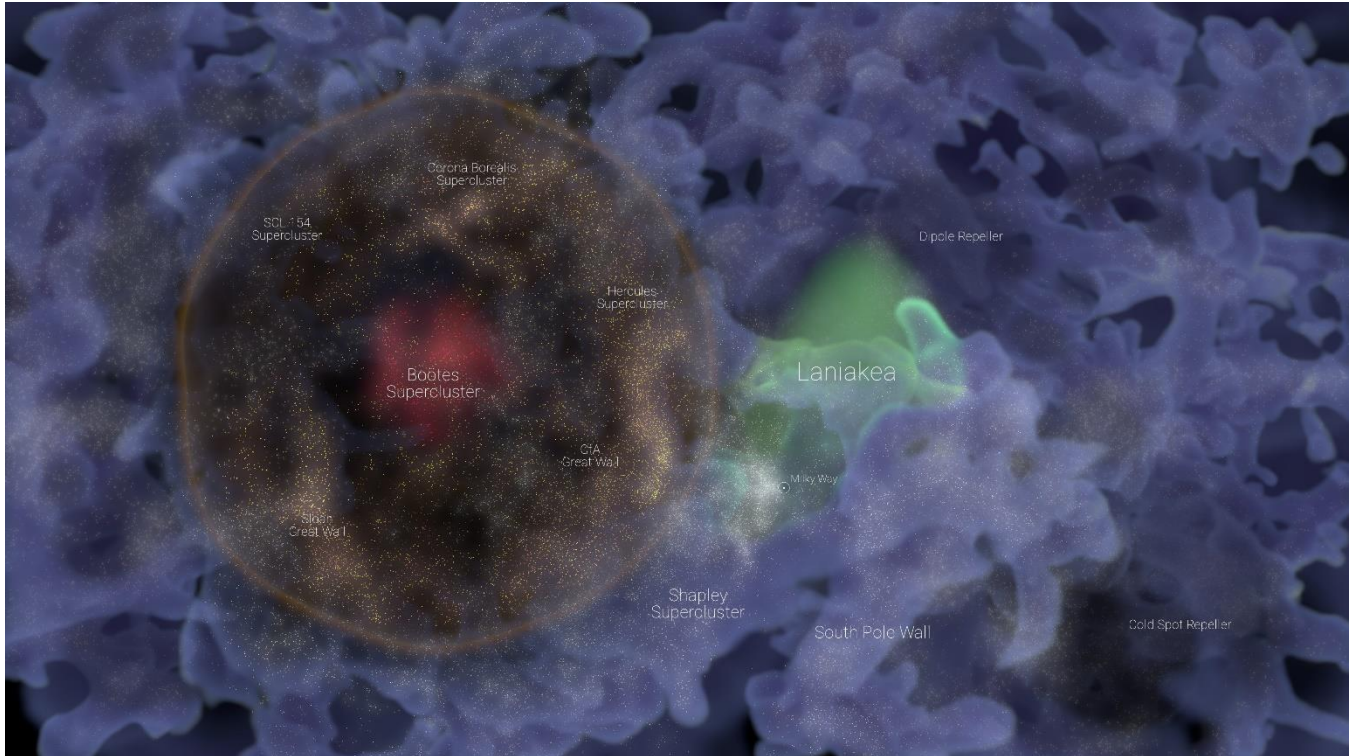

Figure 1. Ho'oleilana. D. Pomarède. Credits: Frédéric Durillon, Animea Studio; Daniel Pomarède, IRFU, CEA University Paris-Saclay; government funding provided by France 2030 (P2I Graduate School of Physics) ref ANR-11-IDEX-0003. https://twitter.com/DanielPomarede/status/1699049162174533919. Adapted from [2].

2. Boötes Void and Superclusters

Wikipedia has this to say about Voids [3]: Cosmic voids are vast spaces between filaments (the largest-scale structures in the universe), which contain very few or no galaxies. The cosmological evolution of the void regions differs drastically from the evolution of the Universe as a whole: there is a long stage when the curvature term dominates, which prevents the formation of galaxy clusters and massive galaxies. Hence, although even the emptiest regions of voids contain more than ~15% of the average matter density of the Universe, the voids look almost empty to an observer. Voids typically have a diameter of 30 to 300 Mly; particularly large voids called supervoids. They were first discovered in 1978 in a pioneering study by S. Gregory and L. A. Thompson.

Voids are believed to have been formed by baryon acoustic oscillations in the Big Bang, collapses of mass followed by implosions of the compressed baryonic matter. Starting from initially small anisotropies from quantum fluctuations in the early universe, the anisotropies grew larger in scale over time. Regions of higher density collapsed more rapidly under gravity, eventually resulting in the large-scale, foam-like structure or "cosmic web" of voids and galaxy filaments seen today. Voids located in high-density environments are smaller than voids situated in low-density spaces of the universe.

According to Wikipedia [4], Boötes Void is one of the largest known voids in the Universe and is referred to as a supervoid. Its discovery was reported by R. Kirshner, *et al.* (1981). The centre of the Boötes Void is approximately 700 Mly from Earth. Other astronomers soon discovered that the void contains a few galaxies. In 1987, J. Moody, R. P. Kirshner, *et al.* published their findings of eight galaxies in the void. M. Strauss and J. Huchra announced the discovery of three more galaxies in 1988, and G. Aldering, G. Bothun, R. P. Kirshner, and R. Marzke announced the discovery of fifteen galaxies in 1989. By 1997, the Boötes Void was known to contain 60 galaxies. A normal region of the universe of this size would usually contain many thousands of bright galaxies. **Most of the galaxies discovered are usually located near the edges of the void.**

There are two superclusters in Boötes within 1 Bly. The nearest one is about 830 Mly away - the second one lies directly behind it at a distance of about 1 Bly. The Boötes superclusters are famous mainly because they lie next to (and slightly behind) the Boötes void. This void is one of the most famous voids in the universe mainly because it was one of the first major voids discovered. The void contains very few galaxies, although there are a lot of foreground galaxies between us and the void. There has been no scientific study of the superclusters in Boötes. Although these superclusters are much bigger than the Virgo supercluster, there are many closer superclusters which are considered to be more interesting [5].

3. Medium of the World

The existence of the Medium is a principal point of the Hypersphere World-Universe Model (WUM). It follows from the observations of Intergalactic Plasma; Cosmic Microwave Background Radiation (CMBR); Far-Infrared Background Radiation. Intergalactic voids discussed by astronomers are, in fact, examples of the Medium in its purest. CMBR is part of the Medium; it then follows that the Medium is an absolute frame of reference. Relative to CMBR rest frame, the Milky Way (MW) galaxy and the Sun are moving with the speed of 552 and 370 $km\ s^{-1}$, respectively. The Medium of the World is Homogeneous and Isotropic. Distribution of Macroobjects (MOs) is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous. In WUM, Physical Laws are determined by the Medium of the World.

The Medium of the World, consisting of protons, electrons, photons, neutrinos, and Dark Matter Particles (DMPs), is an active agent in all physical phenomena in the World. Time, Space and Gravitation are closely connected with the Impedance, Gravitomagnetic parameter, and Energy density of the Medium, respectively. It follows that neither Time, Space nor Gravitation could be discussed in absence of the Medium. WUM confirms the Supremacy of Matter postulated by A. Einstein: *When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter.*

3.1. Energy Density of the World

Imagine that the World is a **Hubble Bubble with a radius $R = c\tau$** (where c is a gravitodynamic constant that is identical to the electrodynamic constant c in Maxwell's equations and τ is a cosmological time) and **an energy density of a spherical surface σ_0** that is a temperature invariant surface enthalpy [6]:

$$\sigma_0 = \frac{hc}{a^3}$$

where h is Planck constant and a is a basic size unit: $a = 1.7705641 \times 10^{-14}\ m$.

With Nikola Tesla's principle at heart – *There is no energy in matter other than that received from the environment* – we calculate an energy of the World E_W:

$$E_w = 4\pi R^2 \sigma_0$$

and an average energy density ρ_W :

$$\rho_W = \frac{3\sigma_0}{R} = \frac{3hc}{a^3 R} = \frac{3hc}{a^4} \frac{a}{R} = 3\rho_0 \times Q^{-1}$$

that is inversely proportional to R . An energy density unit ρ_0 equals to: $\rho_0 = hc/a^4$ and a dimensionless time-varying quantity Q equals:

$$Q_{av} = \frac{a^2 c^4}{8\pi hc} \times G_{av}^{-1} = 0.7599440 \times 10^{40}$$

where G_{av} is the average value of the experimentally measured Gravitational parameter G [7]:

$$G_{av} = \frac{G(1) + G(2)}{2} = 6.674334 \times 10^{-11} m^3 kg^{-1} s^{-2}$$

The 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 (t_0 is a basic time unit: $t_0 = a/c = 5.9059662 \times 10^{-23}$ s):

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

WUM is based on two parameters only: dimensionless Rydberg constant α (later named Fine-structure constant) and time-varying Quantity Q .

3.2. Critical Energy Density

The principal idea of WUM is that ρ_W equals to the critical energy density ρ_{cr} : $\rho_W = \rho_{cr}$, which can be found by considering a sphere of radius R_M and enclosed mass M that can be calculated by multiplication of critical mass density by the volume of the sphere. When the World has the critical density, the Hubble velocity $H \times R_M$ ($H = c/R$ is the Hubble parameter) equals to the escape velocity v_{esc} [8]:

$$v_{esc}^2 = \frac{2GM}{R_M} = \frac{2G}{R_M} \times \frac{4\pi}{3} R_M^3 \times \frac{\rho_{cr}}{c^2} = (H \times R_M)^2$$

which gives an equation for ρ_{cr} :

$$\rho_{cr} = 3H^2 c^2 / 8\pi G$$

This equation can be rewritten as:

$$\frac{4\pi G}{c^2} \times \frac{2}{3}\rho_{cr} = \mu_g \times \rho_M = H^2 = \frac{c^2}{R^2}$$

where $\mu_g = \frac{4\pi G}{c^2}$ is a gravitomagnetic parameter and $\rho_M = \frac{2}{3}\rho_{cr}$ is an energy density of the Medium. Considering that $H \propto R^{-1}$, it is easy to see that the gravitational parameter $G \propto R^{-1}$. We emphasize that the values of the main cosmological parameters G and H depend on the value of ρ_M which is the characteristic of the Medium that is Homogeneous and Isotropic. The critical energy density of the World in the present Epoch equals to [6]:

$$\rho_{cr} = 3\rho_0 \times Q^{-1} = 4.980161 \ GeV/m^3$$

3.3. Dark Matter Particles [9]

WUM proposes multicomponent DM system consisting of two couples of co-annihilating 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 an elementary charge and α is a dimensionless Rydberg constant); 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), and boson XION (10.6 μeV) that is an analog of Axion discussed in literature. In our view, XIONs are responsible for the Le Sage's push mechanism of gravitation.

The reason for this multicomponent DM system was to explain the diversity of DM Cores of MOs of the World (superclusters, galaxies, and extrasolar systems), which are Fermion Compact Objects in our Model. WUM postulates that rest energies of DMFs and bosons are proportional to a basic energy unit $E_0 = hc/a$ multiplied by different exponents of α and can be expressed with following formulae:

DMF1 (fermion): $E_{DMF1} = \alpha^{-2} E_0 = 1.3149948 \ TeV$

DMF2 (fermion): $E_{DMF2} = \alpha^{-1} E_0 = 9.5959804 \ GeV$

DIRAC (boson): $E_{DIRAC} = \alpha^0 E_0 = 70.025252 \ MeV$

ELOP (boson): $E_{ELOP} = 2/3\alpha^1 E_0 = 340.66596 \ keV$

DMF3 (fermion): $E_{DMF3} = \alpha^2 E_0 = 3.7289394 \ keV$

DMF4 (fermion): $E_{DMF4} = \alpha^4 E_0 = 0.19857107 \ eV$

XION (boson) $E_{XION} = \alpha^6 E_0 = 10.574179 \ \mu eV$

It is worth noting that the rest energy of electron E_e equals to: $E_e = \alpha E_0$ and the Rydberg unit of energy is: $Ry = hcR_\infty = 0.5\alpha^3 E_0 = 13.605693 \ eV$.

3.4. Content of the World [9]

One of the principal ideas of WUM holds that relative energy densities of the World's particles in terms of the critical energy density ρ_{cr} are constants in all times and proportional to the proton energy density in the World's Medium ρ_p that in the present Epoch equals to [6]:

$$\rho_p = \frac{2\pi^2 \alpha}{3} \rho_{cr} = 0.048014655 \rho_{cr} = 239.1207 \ MeV/m^3$$

Our Model holds that the energy density of all types of self-annihilating DMPs is proportional to ρ_p . In all, there are 6 different types of self-annihilating DMPs: DMF1, DMF2, DIRAC, ELOP, DMF3, and DMF4. Then the total energy density of DMPs ρ_{DM} is

$$\rho_{DM} = 6 \rho_p = 0.28808793 \rho_{cr}$$

that is in good agreement with the results in [10]. The total XION energy density ρ_{XION} is :

$$\rho_{XION} = 1.35\pi^2 \rho_p = 0.63974563 \rho_{cr}$$

The total baryonic energy density ρ_B is:

$$\rho_B = 1.5 \rho_p$$

The sum of electron and CMBR energy densities ρ_{eCMBR} equals to:

$$\rho_{eCMBR} = 1.5\frac{m_e}{m_p} \rho_p + 2\frac{m_e}{m_p}\rho_p = 3.5\frac{m_e}{m_p} \rho_p$$

We take energy density of neutrinos ρ_ν to equal:

$$\rho_\nu = \rho_{MBR}$$

For Far-Infrared Background Radiation energy density ρ_{FIRB} we take

$$\rho_{FIRB} = \frac{1}{40}\frac{m_e}{m_p}\,\rho_p$$

Then the energy density of the World ρ_W equals to the theoretical critical energy density:

$$\rho_W = \left[1.35\pi^2 + 7.5 + (5.5 + 1/40)\frac{m_e}{m_p}\right]\rho_p = \rho_{cr}$$

From this equation we can calculate the value of $1/\alpha$ using electron-to-proton mass ratio m_e/m_p :

$$\frac{1}{\alpha} = \frac{\pi^2}{60}\left[54\pi^2 + 300 + (220 + 1)\frac{m_e}{m_p}\right] = 137.03600$$

which is in excellent agreement with the commonly adopted value of 137.035999. It follows that there is a direct correlation between constants α and m_e/m_p expressed by the obtained equation. As shown, m_e/m_p is not an independent constant but is instead derived from α .

As a conclusion:
- The World's energy density is inversely proportional to a dimensionless time-varying parameter $Q \propto \tau$ in all cosmological times;
- The particles relative energy densities are proportional to constant α .

3.5. Weak Interaction

According to WUM, strength of gravity is characterized by gravitational parameter G [11]:

$$G = G_0 \times Q^{-1}$$

where $G_0 = \frac{a^2 c^4}{8\pi hc}$ is an extrapolated value of G at the Beginning of the World ($Q = 1$). Q in the present Epoch equals to: $Q = 0.759972 \times 10^{40}$. The range of gravity equals to the size of the World R :

$$R = a \times Q = 1.34558 \times 10^{26} \, m$$

Weak interaction is characterized by the parameter $G_W = G_0 \times Q^{-1/4}$, which is about 30 orders of magnitude greater than G . The range of the weak interaction R_W in the present epoch equals to:

$$R_W = a \times Q^{1/4} = 1.65314 \times 10^{-4} \, m$$

that is much greater than the range of the weak nuclear force ($10^{-16} \Leftrightarrow 10^{-17} \, m$). A volume of Weak interaction V_W is

$$V_W = 1.89242 \times 10^{-11} \, m^3$$

and a critical concentration n_W^{cr} equals to:

$$n_W^{cr} = 5.28424 \times 10^{10} \, m^{-3}$$

The introduced principally new Weak Interaction between DMPs provides integrity of all Macroobjects' Cores (see Section 4), In our view, Weak interaction between particles DMF3 provides integrity of DM Fermi Bubbles (see Section 6).

4. Macroobject Shell Model [11]

In WUM, Macrostructures of the World (Superclusters, Galaxies, Extrasolar systems) have Nuclei made

up of DMFs, which are surrounded by Shells composed of DM and Baryonic Matter. The shells envelope one another, like a Russian doll. The lighter a particle, the greater the radius and the mass of its shell. Innermost shells are the smallest and are made up of heaviest particles; outer shells are larger and consist of lighter particles. A proposed Weak Interaction of DMPs provides integrity of all shells. **Table 1** describes parameters of MOs' Cores, which are 3D fluid balls with a very high viscosity and function as solid-state objects.

Table 1. Parameters of Macroobjects' Cores made up of different Fermions in present Epoch.

Fermion	Rest Energy E_f, MeV	Macroobject Mass M_{max}, kg	Macroobject Radius R_{min}, m	Macroobject Density ρ_{max}, kgm^{-3}
DMF1	1.3×10^6	1.9×10^{30}	8.6×10^3	7.2×10^{17}
DMF2	9.6×10^3	1.9×10^{30}	8.6×10^3	7.2×10^{17}
Electron-Positron	0.51	6.6×10^{36}	2.9×10^{10}	6.3×10^4
DMF3	3.7×10^{-3}	1.2×10^{41}	5.4×10^{14}	1.8×10^{-4}
DMF4	2×10^{-7}	4.2×10^{49}	1.9×10^{23}	1.5×10^{-21}

The calculated parameters of the shells show that:
- Nuclei made up of DMF1 and/or DMF2 compose Cores of dark stars in Galaxies and normal stars in Extrasolar Systems;
- Shells of DMF3 and/or Electron-Positron plasma around Nuclei made up of DMF1 and/or DMF2 make up Cores of Galaxies;
- Nuclei made up of DMF1 and/or DMF2 surrounded by shells of DMF3 and DMF4 compose Cores of Superclusters.

5. Macroobjects Bubbles

In our opinion, **Cosmic Voids** are vast spaces between filaments, which have no galaxies and contain the Medium of the World only with the energy density equals to $2/3\,\rho_{cr}$ but not $\gtrsim 15\%$ of the average matter density of the Universe, as it is supposed in [3]. **Cosmic Bubbles** have boundaries between an internal parts of them and surrounding media with the surface energy density σ_0 .

5.1. Extrasolar Systems

Extrasolar Systems (ESS) are Bubbles with a boundary between ESS and Interstellar Medium that has a surface energy density σ_0 . This vast, bubble-like region of space, which surrounds the Sun, is continuously inflated by solar jets. The outside radius of the Solar Bubble R_{SB} equals to:

$$R_{SB} = (\frac{3M_\odot c^2}{4\pi\sigma_0})^{1/2} \cong 1.1 \times 10^{15} m \cong 0.12\ ly$$

where $M_\odot$ is the mass of the Sun. The value of 3 above follows from the ratio for all MOs of the World: 1/3 of the total mass is in the central MO and 2/3 of the total mass is in the structure around it.

5.2. Galaxies

Milky Way (MW) galaxy is the second-largest spiral galaxy in the Local Group (after Andromeda Galaxy), with its estimated visible stellar disk diameter $D_{MW} = 185 \pm 15\ kly$, thickness of thin stellar disk about $2\ kly$ and mass $M_{MW} = (1.6 - 3.2) \times 10^{42} kg$ [12].

In our view, MW is a Disk Bubble whose boundary with the Intergalactic Medium has a surface energy density σ_0 . The Disk Bubble contains Interstellar Medium (ISM) and (100 – 400) billion ESS. According to WUM, mass of MW equals to:

$$M_{MW} = \frac{\pi D_{MW}^2 \sigma_0}{2c^2}$$

We calculate D_{MW} by the following equation:

$$D_{MW} = (\frac{2M_{MW}c^2}{\pi \sigma_0})^{1/2} = (170 - 240) \, kly$$

The calculated value of the visible stellar disk diameter is in good agreement with its estimated value obtained by astronomers. Considering the average stellar disk diameter $D_{MW} = 185 \, kly$ we can calculate:

- Mass of MW : $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad M_{MW} = 1.92 \times 10^{42} \, kg$

- Average density : $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \rho_{MW} = 4.20 \times 10^{-20} \, kg \, m^{-3}$

- Average concentration of DM particles DMF3 in ISM : $\qquad n_{DMF3}^{ISM} = 3.04 \times 10^{11} \, m^{-3}$

that is significantly larger than the critical concentration n_W^{cr} (see Section 3.5). It means that weak interaction between DM particles DMF3 provides integrity of MW's disk bubble.

Andromeda Galaxy (AG) is a barred spiral galaxy approximately 2.5 Mly from Earth and the nearest large galaxy to MW with about 10^{12} stars. It has an estimated visible stellar disk diameter ~220 kly and mass $(3 \pm 1) \times 10^{42} \, kg$ [13]. Parameters of AG are close enough to the parameters of MW. It seems reasonable that the calculations of the galaxy parameters made above for MW are valid for AG also.

The experimental observations of galaxies in the universe show that most of them are disk galaxies [14]. Considering the fact that the calculated concentrations of DMF3 are significantly larger than the critical concentration, we can suppose that our conclusions for MW are fair for all galaxies in the World.

It is worth noting that in frames of WUM, Galaxies emerged due to the Explosive Volcanic Rotational Fission of Overspinning DM Superclusters' Cores composed of DM particles DMF1, DMF2, DMF3, and DMF4.

As the result of this mechanism, Galaxy Bubbles created, which have look like "Chicken egg" at that time:
- "Yolk" – spinning liquid DM Core of galaxy with high viscosity composed of DMPs (DMF1, DMF2, and DMF3). "Yolk" contains 1/3 of the total galaxy Matter;
- "Albumen" – liquid ISM with low viscosity made of DMF3 with dissolved other DMPs. "Albumen" adds up to 2/3 of the total galaxy Matter;
- "Membrane" – boundary between ISM and Intergalactic Medium with surface energy density σ_0 .

ESS emerge due to the Explosive Volcanic Rotational Fission of Overspinning DM galaxy Core and enter ISM. As a result, galaxy Bubble expands in the plane of the spinning galaxy's DM Core and becomes a Disk Bubble.

5.3. Superclusters

It is worth noting that the Laniakea Supercluster (LSC), a collection of around 10^5 nearby galaxies [15], including MW stretches over 0.52 Bly that corresponds to the calculated diameter of single Bubble made up of DMF4 (see Section 6.2). We emphasize that $\sim 10^5$ nearby galaxies are moving around Centre of LSC. All these galaxies did not start their movement from the "Initial Singularity". The neighboring superclusters have the same structures [16].

13.77 Byr ago, when LSC emerged, the estimated number of DM Supercluster Cores in the World was around $\gtrsim 10^3$. It is unlikely that all of them gave birth to Luminous Superclusters at the same cosmological time being far away from each other. In our view, the World presents a Patchwork Quilt of different Luminous Superclusters, which emerged in various places of the World at different Cosmological times [16].

40

5.4. Parallel Worlds

In WUM, the World is a **Hubble Bubble** with the radius R , the volume $V_W = 4/3\,\pi R^3$, and the energy density of a spherical surface σ_0 [6]. The World is a part of the 3D Finite Boundless Hypersphere of 4D Nucleus of the World, which is expanding in Its fourth spatial dimension. As a result, the Hypersphere with the 3-dimensional surface volume of $V_H = 2\pi^2 R^3$ is evenly stretched. The ratio of V_H to V_W is:

$$V_H/V_W = 1.5\pi = 4.71$$

It means that in the Hypersphere could exist four "Parallel Worlds" with the same laws of physics because all points of the Hypersphere are equivalent and there are no preferred centers or boundaries of It.

According to Wikipedia [17], the CMBR Cold Spot is a region of the sky seen in microwaves that has been found to be unusually large and cold relative to the expected properties of CMBR. The "Cold Spot" is $\cong 70\ \mu K$ colder than the average CMBR temperature (approximately 2.7 K), whereas the root mean square of typical temperature variations is only 18 μK.

Various alternative explanations exist, including so-called Eridanus Supervoid that is an extremely large region of the universe, roughly 0.5 to 1 Bly across and 6 to 10 Bly away, at redshift $z \approx 1$, containing a density of matter much smaller than the average density at that redshift.

A controversial claim by Laura Mersini-Houghton is that it could be the imprint of another universe beyond our own. She said, "*Standard cosmology cannot explain such a giant cosmic hole*" and made the hypothesis that the WMAP cold spot is *"... the unmistakable imprint of another universe beyond the edge of our own*". If true, this provides the first empirical evidence for a parallel universe (though theoretical models of parallel universes existed previously).

6. Dark Matter Bubbles
6.1. Fermi Bubbles [11]

In 2010, gamma-ray observations by Fermi revealed previously unknown features in our galaxy that now called the Fermi Bubbles. These mysterious structures emerge above and below the center of MW, spanning a total length of about 50 kly. They emit higher-energy gamma rays than the rest of the galaxy's disk. A completely unexpected discovery like the Fermi Bubbles is a special treat. However, scientists know that there are many more surprises waiting to be uncovered by Fermi. In the most recent catalog of sources from Fermi's Large Area Telescope, fully a **third of detected source positions are not known to have a gamma-ray emitting object at that location**. What could be producing these gamma rays?

The outlines of the bubbles are quite sharp, and the bubbles themselves glow in nearly uniform gamma rays over their colossal surfaces. Gamma-ray spectrum at Galactic latitude $\leq 10\degree$, without showing any sign of cutoff up to around 1 TeV, remains unconstrained. Years after the discovery of FBs, their origin and the nature of the gamma-ray emission remain unresolved.

M. Su, *et al.* identify a gamma-ray cocoon feature in the southern and north Fermi bubble, a jet-like feature along the cocoon's axis of symmetry. Both the cocoon and jet-like feature have a hard spectrum from 1 to 100 GeV. If confirmed, these jets are the first resolved gamma-ray jets ever seen.

G. Ponti, *et al.* report prominent X-ray structures on intermediate scales (hundreds of parsecs) above and below the plane, which appear to connect the Galactic Centre region to the FBs. These structures, which they term the Galactic Centre 'chimneys', constitute exhaust channels through which energy and mass, injected by a quasi-continuous train of episodic events at the Galactic Centre, are transported from the central few parsecs to the base of the FBs.

D. Hooper and T. R. Slatyer discuss two emission mechanisms in the FBs: inverse Compton scattering and

annihilating DM. In their opinion, the second emission mechanism must be responsible for the bulk of the low-energy, low-latitude emission. The spectrum and angular distribution of the signal is consistent with that predicted from ~10 GeV DMPs annihilating to leptons. This component is similar to the excess GeV emission previously reported by D. Hooper from the Galactic Center.

It is worth noting that a similar excess of gamma-rays was observed in the central region of the Andromeda galaxy (M31). A. McDaniel, *et al.* calculated the expected emission across the electromagnetic spectrum and found that the best fitting models are with the DMP mass 11 GeV.

WUM explains FBs the following way [11]:

- Core of MW is made up of DMPs: DMF1 (1.3 TeV), DMF2 (9.6 GeV), and DMF3 (3.7 keV). The second component (DMF2) explains the excess GeV emission reported by D. Hooper from the Galactic Center. Core rotates with surface speed at equator close to the escape velocity between Gravitational Bursts (GBs), and over the escape velocity at the moments of GBs;
- Bipolar astrophysical jets (which are astronomical phenomena where outflows of matter are emitted as an extended beams along the axis of rotation) of DMPs are ejected from the rotating Core into the Galactic halo along the rotation axis of the Galaxy;
- Due to self-annihilation of DMF1 and DMF2, these beams are gamma-ray jets. The prominent X-ray structures on intermediate scales (hundreds of parsecs) above and below the plane (named the Galactic Centre 'chimneys') are the result of the self-annihilation of DMF3;
- FBs are bubbles whose boundary with the Intergalactic Medium has a surface energy density σ_0. These bubbles are filled with DM particles: DMF1, DMF2, and DMF3. In our Model, FBs are MOs with a mass M_{FB} and diameter D_{FB}, which are proportional to: $M_{FB} \propto Q^{3/2}$ and $D_{FB} \propto Q^{3/4}$ respectively. According to WUM, diameter of FBs equals to:

$$D_{FB} = L_{DMF3} \times Q^{3/4} = \frac{a}{\alpha^2} \times Q^{3/4} = 28.6 \ kly$$

where L_{DMF3} is Compton length of particles DMF3. The calculated diameter is in good agreement with the measured size of the FBs 25 kly and 32.6 kly . Mass and average density ρ_{FB} are:

$$M_{FB} = \frac{\pi D_{FB}^2 \sigma_0}{c^2} = \frac{\pi m_0}{\alpha^4} \times Q^{3/2} \cong 9.16 \times 10^{40} kg$$

$$\rho_{FB} = \frac{6\sigma_0}{D_{FB} c^2} = 6\alpha^2 \rho_0 \times Q^{-3/4} \cong 8.83 \times 10^{-21} kg/m^3$$

Recall that the mass of MW is about: $M_{MW} = (1.6 - 3.2) \times 10^{42} kg$.

In **WUM,** FBs are DMPs Bubbles containing uniformly distributed DM Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays. FBs made up of DMF3 particles resemble a honeycomb filled with DMF1 and DMF2. Weak interaction between DMF3 particles provides integrity of FBs. Gamma rays up to 1 TeV are the result of the self-annihilation of DMF1 (1.3 TeV) and DMF2 (9.6 GeV) in DM Objects, which are MOs whose density is sufficient for the self-annihilation of DMPs to occur. On the other hand, they are much smaller than stars in the World, and have a high concentration in FBs to provide nearly uniform gamma ray glow over their colossal surfaces. The Core of MW supplies FBs with new DMPs through the galactic wind, explaining the brightness of FBs remaining constant during the time of observations. In our opinion, FBs are built continuously throughout the lifetime of MW (13.77 By).

6.2. Boötes Bubbles

By analogy with FBs, we can calculate characteristics of DM Bubbles in conjunction with Superclusters. The main difference between Galaxies and Superclusters is in their outer shells, which composed of particles

DMF3 for Galaxies and of DMF4 for Superclusters. Considering that a Compton length of particles DMF4, L_{DMF4}, is considerably larger than the Compton length of particles DMF3, L_{DMF3}:

$$L_{DMF4} = \frac{1}{\alpha^2} L_{DMF3}$$

we can calculate a diameter of Boötes Bubble (BB) D_{BB}, mass M_{BB}, average density ρ_{BB}, and concentration of DMF4 n_{DMF4}^{BB}:

$$D_{BB} = L_{DMF4} \times Q^{3/4} = \frac{a}{\alpha^4} \times Q^{3/4} = 0.537\ Bly$$

$$M_{BB} = \frac{\pi D_{BB}^2 \sigma_0}{c^2} = \frac{\pi m_0}{\alpha^8} \times Q^{3/2} \cong 3.23 \times 10^{49} kg$$

$$\rho_{BB} = \frac{6\sigma_0}{D_{BB}c^2} = 6\alpha^4 \rho_0 \times Q^{-3/4} = 2\alpha^4 \rho_{cr} \times Q^{1/4} \cong 53\rho_{cr} \cong 4.70 \times 10^{-25} kg/m^3$$

$$n_{DMF4}^{BB} \cong 1.33 \times 10^{12}\ m^{-3} > n_W^{cr} = 5.28424 \times 10^{10}\ m^{-3}$$

It means that Weak interaction between DM particles DMF4 provides integrity of BBs.

It is worth noting that the energy density of the Medium $\rho_M = 2/3\,\rho_{cr}$. Hence, the energy density of Superclusters' Bubbles ρ_{SB} is 79.5 times larger than an energy density of Supervoids ρ_{SV}, which have a concentration of particles DMF4 n_{DMF4}^{SV} smaller than n_W^{cr}:

$$n_{DMF4}^{SV} \cong 1.67 \times 10^{10}\ m^{-3} < n_W^{cr} = 5.28424 \times 10^{10}\ m^{-3}$$

In our view, Boötes Bubbles emerge above and below the center of Boötes Supercluster, spanning a total length of about 1 Bly. We emphasize that the centre of the Boötes Bubbles (BBs) is approximately 700 Mly from the Earth, and there are two superclusters in Boötes within one billion light years: the nearest one is about 830 Mly away - the second one lies directly behind it at a distance of about 1 Bly. The centre of BBs does not coincide with the centers of the Boötes superclusters. Most probably, these structure emerges above and below the center of the first Boötes Supercluster.

By analogy with FBs, we suppose that BBs are DMPs clouds containing uniformly distributed clumps of DM Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays. There are no galaxies inside of BBs. In favor of the existence of **Boötes Bubbles** speaks the fact that the **Boötes Void** is known to contain 60 galaxies only, which are located near the edges of the void (see Section 2).

To confirm the existence of BBs we should make measurements of high-energy X-rays and gamma rays from the Boötes. Considering the high concentration of particles DMF4 in BBs (that is higher than n_W^{cr}), it is possible to observe "Unidentified Infrared Emission Bands" (UIB), which occur around peaks at 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm. In literature, these emissions are observed from circumstellar regions, interstellar media, star-forming regions, and extragalactic objects for which the identity of the emitting materials is unknown. In WUM, we give an explanation of UIB emission based on the self-annihilation of DM particles DMF4 (0.19 eV) and bi-DMF4 (DMF4 pairs) with a rest energy about 0.38 eV. To the best of our knowledge, WUM is the only cosmological model in existence that is consistent with UIB emission phenomenon [18].

7. Conclusion

According to R. B. Tully, C. Howlett, and D. Pomarède, *The interpretation of Ho'oleilana as BAO structure with our preferred analysis implies a value of the Hubble constant of* $76.9_{-4.8}^{+8.2}\ kms^{-1}Mpc^{-1}$. *This value of Hubble constant is more consistent with what is found from other direct local Universe probes* —$H_0 = 69.8 \pm 0.6(stat) \pm 1.6(sys)\ km\ s^{-1}Mpc^{-1}$ *(Freedman, et al. 2020);* $H_0 = 73.1 \pm 1.0\ km\ s^{-1}Mpc^{-1}$ *(Riess, et al. 2022);* $74.6 \pm 3.0\ km\ s^{-1}Mpc^{=1}$ *(Tully, et al. 2023) - rather than the value of* $H_0 = 67.4 \pm 0.5\ km\ s^{-1}Mpc^{-1}$

inferred from propagating the early Universe constraints (Planck Collaboration, et al. 2020). By implication, if Ho'oleilana is representative of the statistical population of BAO, **additional late-time physics may be required to increase the expansion rate of the Universe towards the present day.**

It is worth noting that in frames of WUM the calculated value of Hubble constant in 2013 [6]:

$$H_0 = 68.733 \; km \; s^{-1} Mpc^{-1}$$

is in excellent agreement with the most recent measured value in 2021:

$$H_0 = 68.7 \pm 1.3 \; km \; s^{-1} Mpc^{-1}$$

using the Cosmic Microwave Background data only [19].

We emphasize that the values of the main cosmological parameters G and H depend on the value of the energy density ρ_M which is the characteristic of the **Medium** that is Homogeneous and Isotropic (see Section 3.2). In frames of WUM, **there is no need to invent new Physical Laws** for describing early stages of the World observed by JWST and by R. B. Tully, *et al.* We can use the well-known equations considering time-varying physical parameters G and H.

Acknowledgments

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Dark Galaxies, Sun-Earth-Moon Interaction, Tunguska Event – Explained by WUM

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Abstract

Great experimental results and observations achieved by Astronomy in the last decades revealed new unexplainable phenomena. Astronomers have conclusive new evidence that a recently discovered "dark galaxy" is, in fact, an object the size of a galaxy, made entirely of dark matter. They found that the speed of the Earth's rotation varies randomly each day. 115 years ago, the Tunguska Event was observed, and astronomers still do not have an explanation of It. Main results of the present article are:

1) **Dark galaxies** explained by the spinning of their Dark Matter Cores with the surface speed at equator less than the escape velocity. Their Rotational Fission is not happening. Extrasolar systems do not emerge;

2) **21-cm Emission** explained by the self-annihilation of Dark Matter particles XIONs (5.3 μeV);

3) **Sun-Earth-Moon Interaction** explained by the influence of the Sun's and the Moon's magnetic field on the electrical currents in the Geomagma (the 660-km layer), and, as a result, the Earth's daylength varies;

4) **Tunguska Event** explained by the huge atmospheric explosion of the Superbolide, which was a stable Dark Matter Bubble before entering the Earth's atmosphere.

1. Introduction

John Michell (1724 –1793) was an English natural philosopher and clergyman who provided pioneering insights into a wide range of scientific fields including astronomy, geology, optics, and gravitation. Considered "*one of the greatest unsung scientists of all time*", he is the first person known to have proposed the existence of "**Dark Stars**". Michell suggested that there might be many "dark stars" in the universe and proposed that astronomers could detect "dark stars" by looking for star systems which behaved gravitationally like two stars, but where only one star could be seen. It was an extraordinarily accurate prediction of binary systems, in which a "dark star" and a normal star orbit around their center of mass. In the Milky Way galaxy there are a dozen such binary systems emitting X-rays [1]. The first known binary system was Cyg X-1 (1971).

The hypothesis of Dark Stars was developed by well-known scientists : F. Bessel (1844); Lord Kelvin (1904); H. Poincare (1906); F. Zwicky (1933); E. Ripamonti and T. Abel (2005); D. Spolyar, K. Freese, and P. Gondolo (2007); K. Freese, T. Rindler-Daller, D. Spolyar, and M. Valluri (2015). C. Ilie, J. Paulin, and K. Freese (2023) in the article "Supermassive Dark Star candidates seen by JWST?" wrote: "*The first generation of stars in the Universe is yet to be observed. There are two leading theories for those objects that mark the beginning of the cosmic dawn: hydrogen burning Population III stars and Dark Stars, made of hydrogen and helium but powered by Dark Matter heating. We show that each of the following three objects: JADES-GS-z13-0 , JADES-GS-z12-0 , and JADES-GS-z11-0 (at redshifts z ∈ [11, 14]) are consistent with a Supermassive Dark Star interpretation, thus identifying, for the first time, Dark Star candidates*"[2].

It is worth noting that in 2013 we proposed a principally different explanation of supermassive compact objects: "*Macroobjects of the World have cores made up of the discussed DM particles. Other particles, including DM and baryonic matter, form shells surrounding the cores. The first phase of stellar evolution in the history of the World may be dark stars, powered by Dark Matter heating rather than fusion*" [3].

2. Dark Galaxies
2.1. Observations

A truly "dark galaxy'" is an isolated halo consisting only of Dark Matter (DM). In some scenarios, it is possible that some optically dark objects may contain enough HI (atomic hydrogen) that a blind HI survey would detect them. A good example of a "dark" object is the southwestern (SW) component of the binary system known as **HI1225+01**, discovered serendipitously at Arecibo by R. Giovanelli and M. Haynes in 1989. While the northeastern HI component hosts a small, star forming dwarf, the SW component has no detectable stellar counterpart. It is not an isolated object, being part of an apparent **binary system** [4].

Initially discovered in 2000, **VIRGOHI 21** was announced in 2005 as a good candidate to be a true dark Galaxy. R. Minchin, *et al.* in the article "21-cm Synthesis Observations of VIRGOHI 21 – a Possible Dark Galaxy in the Virgo Cluster" say: "*Many observations indicate that dark matter dominates the extra-galactic Universe, yet not dark structure of galactic proportions has ever been convincingly identified. Previously we have suggested that VIRGOHI 21, a **21-cm source** we found in the Virgo Cluster, was a possible dark galaxy because of its **broad line-width** (~200 km s^{-1}) unaccompanied by any visible gravitational source to account for it. We have now imaged VIRGOHI 21 in the neutral-hydrogen line and find what could be a dark, edge-on, spinning disk with the mass and diameter of a typical spiral galaxy. Moreover, **VIRGOHI 21 has unquestionably been involved in an interaction with NGC 4254**, a luminous spiral with an odd one-armed morphology, but lacking the massive interactor normally linked with such a feature. We have also used the Hubble Space Telescope to search for stars associated with the HI and find none*"[5].

The cloud is at the Virgo cluster's distance of 52 Mly. It is roughly 50 kly across, about half the diameter of the Milky Way (MW) galaxy's' starry disk. The strength of the 21-cm emission indicates that the cloud harbors 2×10^7 $M_\odot$ of atomic hydrogen — about one-tenth MW supply. "*But the cloud's total mass is much greater, implying that, like most galaxies (including our own), it consists primarily of dark matter. Astronomers estimates the cloud's mass is at least 9×10^{10} $M_\odot$*"[5].

Based on HI survey, J-L. Xu, *et al.* obtained HI mass 8.3×10^7 $M_\odot$ of the galaxy **FAST J0139+4328**. Their findings provide observational evidence that this galaxy is an isolated dark dwarf galaxy with a redshift of z=0.0083. This is the first time that an isolated dark galaxy has been detected in the nearby universe [6].

A galaxy **J0613+52** has about the same characteristics of mass and gas content as a normal spiral galaxy. There are no galaxies within 112 Mpc, making it a pretty isolated target. O'Neil and a team of colleagues found "*that it's an incredibly gas rich galaxy. It's not demonstrating star formation like we'd expect, probably because its gas is too diffuse. At the same time, it's too far from other galaxies for them to help trigger star formation through any encounters. J0613+52 appears to be both undisturbed and underdeveloped. This could be our first discovery of a nearby galaxy made up of primordial gas*"[7] (see **Figure 1**).

2.2. 21-cm Emission

The hydrogen line (HI line) is a spectral line that is created by a change in the energy state of electrically neutral hydrogen atoms. It is produced by a spin-flip transition, which means the direction of the electron's spin is reversed relative to the spin of the proton. This is a quantum state change between the two hyperfine levels of the hydrogen 1s ground state. The electromagnetic radiation producing this line has a frequency of 1420.4058 MHz, which is equivalent to a wavelength of 21.106114 cm in a vacuum and a transition energy of 5.8743262 μeV. Neutral atomic hydrogen constitutes about 75% of the baryonic mass of the universe. All HI regions do not emit detectable visible light but are observed by the **21-cm region spectral line**. This line has a very low transition probability, so it requires large amounts of hydrogen gas for it to be seen.

Figure 1. Artist depiction of hydrogen gas observed in galaxy J0613+52. The colors indicate the likely rotation of the gas relative to the observer (red=away, blue=toward). This image was made using a starfield from STScI POSS-II with additional illustration by NSF/GBO/P. Vosteen. Adapted from [8].

According to M. Padovani, *et al.*, (2018) "*Small amounts of atomic hydrogen, detected as absorption dips in the 21 cm line spectrum, are a well-known characteristic of dark clouds.* **The abundance of hydrogen atoms measured in the densest regions of molecular clouds can only be explained by the dissociation of H_2 by cosmic rays**" [9].

A. Liu, *et al.* (2022) provide an excellent review of 21-cm emission: "*The 21cm line refers to a* **forbidden transition** *in neutral hydrogen associated with alignment of spins of the proton and electron. It is a very low energy transition that is emitted whenever there is neutral hydrogen in the Universe. Since baryons are mostly (~75%) hydrogen, one can in principle detect this emission throughout much of the history of the Universe. The dominant emission mechanism is different across cosmic ages. Before the photons decouple from matter, hydrogen is in an ionized state and does not emit in 21cm. After recombination and during the Dark Ages, at z ~ 30-1000, the 21cm emission is associated with density fluctuations in the neutral hydrogen medium. After the first stars turn on and galaxies begin to form, the 21cm emission traces bubbles of ionized hydrogen in the sea of the neutral medium. This epoch, spanning z ~ 6-30, is often referred to as cosmic dawn and the Epoch of Reionization. At redshifts below z<6, the intergalactic medium is largely ionized, but pockets of self-shielded neutral gas form in dense galactic environments and 21cm emission traces the distribution of galaxies. The vastly different emission mechanisms allow us to probe very different physics at different redshifts, corresponding to different observational frequencies*" [10].

In the case of **SDSSJ0826+5630**, the radio wave signal was magnified by another galaxy between the early galaxy acting as a lensing body. N. Roy said that "*this effectively results in the magnification of the signal by a factor of 30, allowing the telescope to pick it up*" [11].

R. Mondal and R. Barkana in the article "Prospects for precision cosmology with the 21 cm signal from the dark ages," say that "*the 21 cm signal from the dark ages provides a potential new probe of fundamental cosmology. While exotic physics could be discovered, here we quantify the expected benefits within the*

standard cosmology. A measurement of the global (sky-averaged) 21 cm signal to the precision of thermal noise from 1,000 h integration would yield a measurement within 10% of a combination of cosmological parameters. A 10,000 h integration would improve this measurement to 3.2% and constrain the cosmic helium fraction to 9.9%. Precision cosmology with 21 cm fluctuations requires a collecting area of $10\ km^2$ *(corresponding to 400,000 stations), which, with a 1,000 h integration, would exceed the same global case by a factor of ~2. Enhancing the collecting area or integration time by an order of magnitude would yield a 0.5% parameter combination, a helium measurement five times better than Planck*" [12].

3. Formation of Macrostructures [1]

3.1. Multicomponent Dark Matter

Hypersphere World-Universe Model (WUM) proposes multicomponent DM system consisting of two couples of co-annihilating Dark Matter Particles (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 an elementary charge and α is a dimensionless Rydberg constant); 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), DMF4 (0.2 eV), and boson XION (5.3 μeV) that is an analog of Axion discussed in literature.

Axion is a hypothetical elementary particle postulated by the Peccei–Quinn theory to resolve the strong CP problem in quantum chromodynamics. With a rest energy about $5\ \mu eV$, axions could account for DM, and thus be both DM candidate and a solution to strong CP problem [13]. In our view, XIONs are responsible for the Le Sage's push mechanism of gravitation.

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 (MOs) of the World (Superclusters, Galaxies, and Extrasolar Systems (ESS)), which are Fermion Compact Objects and DM Reactors (DMRs) in WUM.

WUM postulates that rest energies of DMFs and bosons are proportional to a basic energy unit $E_0 = hc/a$ (where h is Planck constant, c is a gravitodynamic constant that is identical to the electrodynamic constant c in Maxwell's equations and a is a basic size unit: $a = 1.7705641 \times 10^{-14}\ m$) multiplied by different exponents of α and can be expressed with following formulae:

DMF1 (fermion):	$E_{DMF1} = \alpha^{-2}E_0 = 1.3149948\ TeV$
DMF2 (fermion):	$E_{DMF2} = \alpha^{-1}E_0 = 9.5959804\ GeV$
DIRAC (boson):	$E_{DIRAC} = \alpha^0 E_0 = 70.025252\ MeV$
ELOP (boson):	$E_{ELOP} = 2/3\alpha^1 E_0 = 340.66596\ keV$
DMF3 (fermion):	$E_{DMF3} = \alpha^2 E_0 = 3.7289394\ keV$
DMF4 (fermion):	$E_{DMF4} = \alpha^4 E_0 = 0.19857107\ eV$
XION (boson)	$E_{XION} = 1/2\alpha^6 E_0 = 5.2870895\ \mu eV$

It is worth noting that the rest energy of electron E_e equals to: $E_e = \alpha E_0$ and the Rydberg unit of energy is: $Ry = hcR_\infty = 1/2\alpha^3 E_0 = 13.605693\ eV$.

3.2. Macroobject Shell Model

In WUM, Macrostructures of the World (Superclusters, Galaxies, Extrasolar systems) have Nuclei made up of DMFs, which are surrounded by Shells composed of DM and Baryonic Matter. The shells envelope one another, like a Russian doll. The lighter a particle, the greater the radius and the mass of its shell. Innermost

shells are the smallest and are made up of heaviest particles; outer shells are larger and consist of lighter particles. A proposed Weak Interaction of DMPs provides integrity of all shells. **Table 1** describes parameters of MOs' Cores, which are 3D fluid balls with a very high viscosity and function as solid-state objects.

Table 1. Parameters of Macroobjects' Cores made up of different Fermions in present Epoch.

Fermion	Rest Energy E_f, MeV	Macroobject Mass M_{max}, kg	Macroobject Radius R_{min}, m	Macroobject Density ρ_{max}, kgm^{-3}
DMF1	1.3×10^6	1.9×10^{30}	8.6×10^3	7.2×10^{17}
DMF2	9.6×10^3	1.9×10^{30}	8.6×10^3	7.2×10^{17}
Electron-Positron	0.51	6.6×10^{36}	2.9×10^{10}	6.3×10^4
DMF3	3.7×10^{-3}	1.2×10^{41}	5.4×10^{14}	1.8×10^{-4}
DMF4	2×10^{-7}	4.2×10^{49}	1.9×10^{23}	1.5×10^{-21}

The calculated parameters of the shells show that:
- Nuclei made up of DMF1 and/or DMF2 compose Cores of dark stars in Galaxies and normal stars in Extrasolar Systems;
- Shells of DMF3 and/or Electron-Positron plasma around Nuclei made up of DMF1 and/or DMF2 make up Cores of Galaxies;
- Nuclei made up of DMF1 and/or DMF2 surrounded by shells of DMF3 and DMF4 compose Cores of Superclusters.

3.3. Angular Momentum

Angular Momentum problem is one of the most critical problems in Standard model that must be solved. To the best of our knowledge, the developed WUM is the only one cosmological model in existence that is consistent with the Law of Conservation of Angular Momentum.

In our opinion, there is only one mechanism that can provide angular momenta to Macroobjects (MOs) – **Rotational Fission** (RF) 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 **rotational momenta of prime objects should exceed orbital momenta of their satellites**.

In frames of WUM, Prime Objects are DM Cores of Superclusters, which must accumulate tremendous angular momenta before the Birth of the Luminous World. It follows that a long enough time period must elapse. We named this period "Dark Epoch" and developed a New Cosmology of the World [14]:
- WUM introduces Dark Epoch (spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr) when only DM MOs existed, and Luminous Epoch (ever since for 13.77 Byr) when Luminous MOs emerged due to RF of Superclusters' DM Cores and self-annihilation of DMPs;
- Main players of the World are Superclusters' DM Cores that accumulated tremendous rotational angular momenta during Dark Epoch and transferred it to DM Cores of Galaxies during their RF;
- The experimental observations of galaxies in the World show that most of them are disk galaxies. These results speak in favor of the developed RF mechanism;
- MW's DM Core was born 13.77 Byr ago as the result of RF of Virgo Supercluster's DM Core;
- DM Cores of ESS, planets and moons were born as the result of the repeating RFs of Galaxy's DM Cores in different times (4.57 Byr ago for Solar System (SS) in MW);
- MOs of the World form from the top (superclusters) down to galaxies, ESS, planets, and moons.

3.4. Formation of Macrostructures

In WUM, Cores of all MOs possess the following properties:

- Their Nuclei are made up of DMFs and contain other particles, including DM and Baryonic matter, in shells surrounding the Nuclei;
- DMPs are continuously absorbed by Cores of all MOs. Ordinary Matter (about 2.4% in MOs and 4.8% in the Medium of the total Matter) is a byproduct of DMPs self-annihilation. It is re-emitted by Cores of MOs continuously. MOs' cores are essentially DMRs fueled by DMPs. All chemical elements, radiations, compositions are produced by MOs themselves as the result of DMPs self-annihilation in their DM cores;
- Nuclei and shells are growing in time: size $\propto \tau^{1/2}$; mass $\propto \tau^{3/2}$; and rotational angular momentum $\propto \tau^2$ (τ is an absolute cosmological time), until they reach the critical point of their stability, at which they detonate. Satellite's cores and their orbital L_{orb} and rotational L_{rot} angular momenta released during detonation are produced by Overspinning DM Cores (ODMCs). The detonation process does not destroy ODMCs; it is rather gravitational hyper-flares;
- Size, mass, composition, angular momentum L_{orb} and L_{rot} of satellite DM cores depend on local density fluctuations at the edge of ODMC and cohesion of the outer shell. Consequently, the diversity of satellite DM cores has a clear explanation. Satellite DM cores are given off by "**Volcanoes**" on prime DM Cores erupting repeatedly;
- WUM refers to ODMC detonation process as Gravitational Burst (GB), analogous to Gamma Ray Burst. In frames of **WUM**, the repeating GBs can be explained the following way:
- As the result of GBs, ODMCs lose a small fraction of their mass and a large part of their rotational angular momentum;
- After GBs, DM Cores of Prime Objects (superclusters and galaxies) absorb new DMPs. Their masses increase $\propto \tau^{3/2}$, and their angular momenta L_{rot} increase much faster $\propto \tau^2$, until they detonate again at the next critical point of their stability. That is why DM cores of Satellites (galaxies and ESS) are rotating around their own axes and DM Cores of Prime Objects;
- Afterglow of GBs is a result of processes developing in the Nuclei and shells after detonation;
- In case of ESS, a star wind is the afterglow of star detonation: Star's DM Core absorbs new DMPs, increases its mass $\propto \tau^{3/2}$ and gets rid of extra L_{rot} by star wind particles;
- Solar wind is the afterglow of Solar Core detonation 4.57 Byr ago. It creates the SS bubble continuously;
- In case of Galaxies, a galactic wind is the afterglow of repeating galactic DM Core detonations. In MW it continuously creates two DM Fermi Bubbles.
  In frames of the developed RF model, the following discoveries can be explained:
- Gravitational Birst of ODMC of Virgo Supercluster 13.77 Byr ago gave birth to Sgr A* , the Core of MW;
- Gravitational Birst of ODMC of MW 13.77 Byr ago gave birth to the core of the eldest Methuselah star;
- Gravitational Birst of ODMC of MW 5 Myr ago gave birth to the binary system Cyg X-1 at the same time, moreover dark star is the rotating DM core made of DMF1 and DMF2 with the surface speed at equator less than the escape velocity. Both stars have Halos made of DMF3 particles (3.7 keV) emitting X-rays as the result of their self-annihilation.

3.5. WUM Explanation

A summary of the Dark Galaxies (DGs) observations is as follows:

- DG **HI1225+01** is the binary system;
- DG **VIRGOHI 21** has unquestionably been involved in an interaction with NGC 4254;
- DG **FAST J0139+4328** is an isolated dark dwarf galaxy;
- There are no galaxies within 112 Mpc, making DG **J0613+52** a pretty isolated target;

- The likely rotation of the gas in DG **J0613+52** relative to the observer;
- The abundance of hydrogen atoms measured in the densest regions of molecular clouds can only be explained by the dissociation of H_2 by cosmic rays;
- The **21-cm region spectral line** refers to a forbidden transition in neutral hydrogen. It has a very low transition probability, so it requires large amounts of hydrogen gas for it to be seen;
- A measurement of the global (sky-averaged) 21-cm signal to the precision of thermal noise from 1,000 h integration would yield a measurement within 10% of a combination of cosmological parameters. A 10,000 h integration would improve this measurement to 3.2%. Precision cosmology with 21-cm fluctuations requires a collecting area of 10 km^2.

In frames of **WUM**, DM Galaxies emerged due to the Explosive Volcanic Rotational Fission of Overspinning DM Superclusters' Cores composed of DM particles DMF1, DMF2, DMF3, and DMF4. As the result of this mechanism, DM Galaxy Bubbles (GBs) created, which have look like "Chicken egg" at that time:

- "Yolk" – spinning liquid DM Core of galaxy with high viscosity composed of DMPs (DMF1, DMF2, and DMF3). "Yolk" contains 1/3 of the total galaxy Matter;
- "Albumen" – liquid Intragalactic Medium (IGM) with low viscosity made of DMF3 with dissolved other DMPs (DMF4 and XIONs). Weak interaction between particles DMF3 provides integrity of GBs. "Albumen" adds up to 2/3 of the total galaxy Matter;
- "Membrane" – boundary between IGM and Intergalactic Medium with surface energy density $\sigma_0 = hc/a^3$ According to **WUM**:
- Molecular clouds discussed in the literature are Galaxy Bubbles;
- In case of Dark galaxy, DM Core is spinning with the surface speed at equator less than the escape velocity. Its RF is not happening. ESS do not emerge;
- By analogy with binary dark star system Cyg X-1, the binary dark galaxy system **VIRGOHI 21** was created at the same time as a result of the volcanic RF of ODMC of the Virgo Supercluster, moreover dark galaxy is a rotating DM core made of DMF1, DMF2 , and DMF3 with the surface speed at equator less than the escape velocity. The same mechanism is valid for the binary DG system **HI1225+01;**
- Concentration of DM particles XIONs (rest energy $5.287 \ \mu eV$) inside of GB is considerably larger (about 5 orders of magnitude) than in the Intergalactic Medium. They are ultra-relativistic particles and have total energies larger than the rest energy up to $\gtrsim 5.874 \ \mu eV$. A self-annihilation of an ensemble of XIONs with energies about $5.874 \ \mu eV$ produces $21 \ cm$ radiation with broad line-width. Considering the poor accuracy of 21-cm emission measurements, we can deem that the developed approach is valid.

In frames of **WUM**, there is no need in hydrogen atoms, for which there is no explanation for a mechanism of their production and concentration in the World. The developed mechanism gives a good explanation for all observed results for Dark Galaxies summarized above.

4. Sun-Earth-Moon Interaction [17]

4.1. Earth-Moon Interaction

G. Jones and K. Bikos in an article "Earth Is in a Hurry in 2020" wrote: "*When highly accurate atomic clocks were developed, they showed that the length of a mean solar day can vary by milliseconds. These differences are obtained by measuring the Earth's rotation with respect to distant astronomical objects*". It turned out that the variations of the daylength throughout 2020 were in the range $86400^{+1.62ms}_{-1.46ms} \ s$. *The speed of the Earth's rotation varies constantly because of the complex motion of its molten core, oceans and atmosphere, plus other effects* (see **Figure 2**).
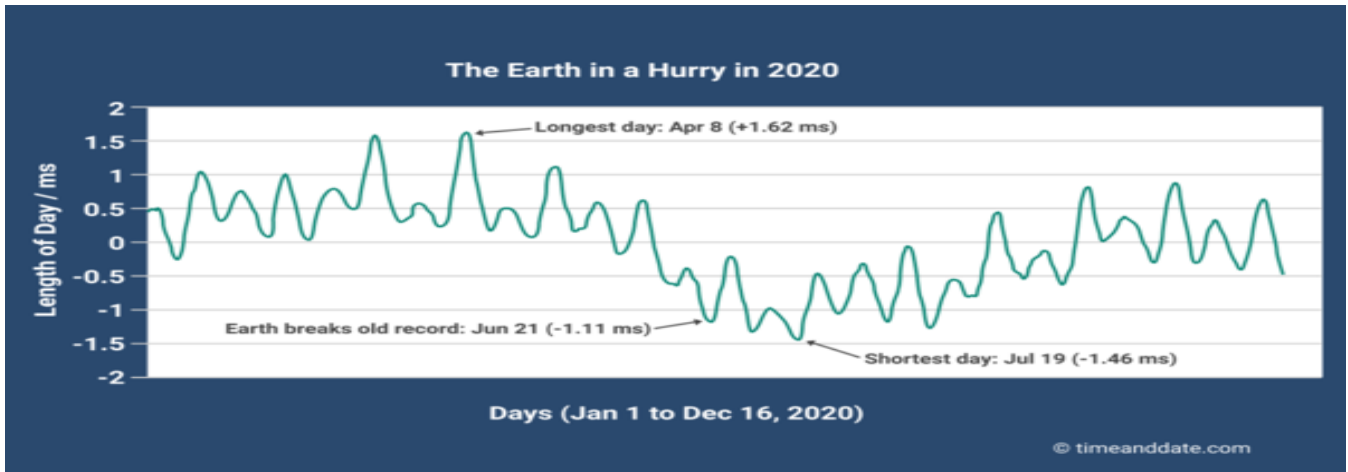
Figure 2. Variation of daylength throughout 2020. The length of day is shown as the difference in milliseconds (ms) between the Earth's rotation and 86,400 seconds. Adapted from [15].

It is worth noting that there is some kind of periodicity of peaks on **Figure 2**. We used the data obtained by Jones, G., Bikos, K., and Hocken V. [16] and got Variation of daylength throughout 2023 (see **Figure 3**).
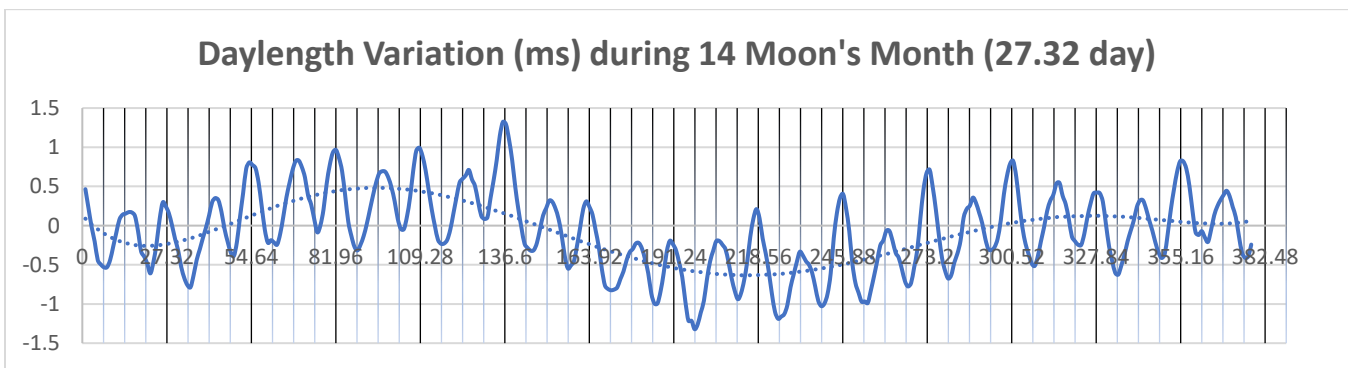

Figure 3. Variation of daylength around SI based 86400 s throughout 2023.

As a result, we found similar peaks with a revealed perfect periodicity 6.83 Earth days, which equals to the quarter of the Moon's sidereal rotation period (fixed star to fixed star) 27.32 Earth days.

4.2. Sun-Earth Interaction

For detailed analysis of year's variations, we used the data obtained by Jones, G., Bikos, K., and Hocken V. [16] and got a deviation of average daylength since 1973 to 2023 (see **Figure 4**).
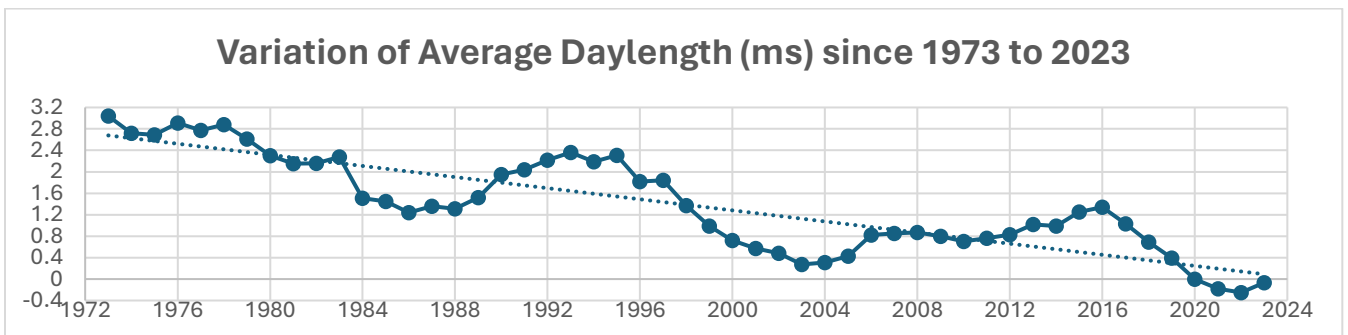

Figure 4. Variation of average daylength around SI based 86400 s since 1973 to 2023. Adapted from [16].

Analysis of the presented results shows that maxima of the average daylengths were observed at 2016, 2006, 1995, 1983, and 1972 (see **Figure 4**), which are about 11 years apart.

It is interesting that the full solar cycle is actually a 22-year phenomenon. The sunspot cycle happens because of the magnetic pole flip — north becomes south and south becomes north—approximately every 11 years. Some 11 years later, the poles reverse again back to where they started. The sun behaves similarly over the course of each 11-year cycle no matter which pole is on top.

Analysis of Sunspot numbers for a period of 400 years (1610-2010) shows that the maximum Sun activity at 2016, 2006, 1995, 1983, and 1972 causes the maximum Geomagma activity and maximum of the average daylengths (see Section 4.3).

4.3. WUM Explanation

In frames of WUM, random variations of the Earth's rotational speed on a daily basis can be explained by variations in the activity of the Earth's DMR and the 660-km layer that we named Geomagma. As the result of DMPs self-annihilation, random mass ejections in Geomagma are happening. During a time of high DMR activity, the Earth's rotational speed is lower (long days) due to increase of Earth's moment of inertia. When random mass ejections are less frequent, the Earth's moment of inertia is decreasing, we observe short days.

Analysis of the estimated values of the masses and shifts of the Geomagma [17] show that:

- There is no way to explain the random variations of the speed of the Earth's rotation by the complex motion of oceans and atmosphere as it was supposed by G. Jones and K. Bikos [15];
- They can be explained by random mass ejections in the Geomagma only.

It is worth noting that since 1973 to 2023 (see **Figure 4**), the averaged deviation of the average daylength dropped down from 2.7 ms to 0.1 ms. In frames of WUM, we found that during 50 years of observations the average length of the day should be shorter by $1.9 \, ms$, which is in good agreement with the experimentally observed value $2.6 \, ms$ [17].

Earth – Moon interaction means that a "Lunarmagma", electrical currents of which define the Moon's magnetic field, influences Geomagma electrical currents and, as a result, changes the Earth's daylength. The same way, "Solarmagma", electrical currents of which define the Sun's magnetic field, influences Geomagma. So, there are Large-scale (years) and Small-scale (days) variations of daylength defined by Sun and Moon.

5. Tunguska Event [18]

Observations. On 30 June 1908 at around 07:17 AM local time, Evenki natives and Russian settlers in the hills northwest of Lake Baikal observed a **bluish light**, nearly as bright as the Sun, moving across the sky and leaving a thin trail. About ten minutes later, there was a sound similar to artillery fire. The explosion registered at seismic stations across Eurasia, and air waves from the blast were detected in Germany, Denmark, Croatia, and the United Kingdom – and as far away as Batavia, Dutch East Indies, and Washington, D.C. It is estimated that, in some places, the resulting shock wave was equivalent to an earthquake measuring 5.0 on the Richter magnitude scale.

Description. Tunguska event was an explosion, estimated to have a yield of at least 3 – 30 Mt of TNT. The explosion is generally attributed to a **meteor air burst**: atmospheric explosion of a stony asteroid about 50–60 meters in size. The asteroid approached probably with a relatively high speed of about 27 km/s . Though it is classified as an impact event, the object is thought to have exploded at an altitude of 5 to 10 km rather than having hit the Earth's surface, leaving no impact crater. There have been about 1,000 scholarly papers (most in Russian) published about the Tunguska explosion.

Meteor Air Burst is a type of air burst in which a meteoroid explodes after entering a planetary body's atmosphere. This fate leads them to be called **fireballs** or **bolides**, with the brightest air bursts known as **superbolides**. Such meteoroids were originally asteroids and comets of a few to several tens of meters in diameter. A bolide as a fireball reaching an apparent magnitude of −14 or brighter – more than twice as bright as the full moon. A superbolide is a bolide that reaches an apparent magnitude of −17 or brighter, which is roughly 100 times brighter than the full moon.

Recent examples of superbolides include the Sutter's Mill meteorite in California (energy yield of ~4 kt of TNT), the Chelyabinsk meteor in Russia (the explosive energy 460–470 kt of TNT), and the Kamchatka meteor in Russia, which was an asteroid roughly 10 meters in diameter that entered the atmosphere at a speed of 32.0 km/s, with a TNT equivalent energy of 173 kt. This energy was more than 10 times the energy of the "Little Boy" bomb dropped on Hiroshima in 1945.

Early estimates of the energy of the Tunguska air burst ranged from (10–15) Mt of TNT to 30 Mt of TNT, depending on the exact height of the burst as estimated when scaling laws from the effects of nuclear weapons are employed. The 15 Mt estimate represents an energy about 1,000 times greater than that of "Little Boy" bomb. It equals to that of the United States' Castle Bravo nuclear test in 1954 (15.2 Mt) and one third that of the Soviet Union's Tsar Bomba test in 1961. US Government Sensors reported 971 entries of fireballs from May 1988 to December 2023.

Earth impactor model. Meteoroids enter the Earth's atmosphere from outer space traveling at speeds of at least 11 km/s and often much faster. Despite moving through the rarified upper reaches of Earth's atmosphere the immense speed at which a meteor travels rapidly compresses the air in its path. The meteoroid then experiences what is known as ram pressure. As the air in front of the meteoroid is compressed its temperature quickly rises. This is not due to friction, rather it is an adiabatic process, a consequence of many molecules and atoms being forced to occupy a smaller space. Ram pressure and the very high temperatures it causes are the reasons few meteors make it all the way to the ground. Most simply burn up or are ablated into tiny fragments. Larger or more solid meteorites may explode instead.

As theorized by G. Kuiper in 1951, a disc-like belt of icy bodies exists beyond Neptune. These icy objects, occasionally pushed by gravity into orbits bringing them closer to the Sun become the so-called short-period comets with less than 200 years to orbit the Sun.

A **comet** is an icy, small SS body with nuclei composed of loose collections of ice, dust, and small rocky particles. There are two main classes of Comets: short-period comets (called ecliptic comets) and long-period comets (called isotropic comets). Ecliptic comets have relatively small orbits, below 10 AU, and follow the ecliptic plane, the same plane in which the planets lie. All long-period comets have very large orbits, thousands of AU, and appear from every direction in the sky. How and when comets formed is debated, with distinct implications for SS formation, dynamics, and geology.

An **asteroid** is a minor planet—an object that is neither a true planet nor a comet—that orbits within the inner SS between the orbits of Mars and Jupiter They are rocky, metallic or icy bodies. Sizes and shapes of asteroids vary significantly, ranging from 1-meter rocks to a dwarf planet almost 1000 km in diameter. The total mass of the asteroid belt is about 3% that of the Moon.

In **WUM**, Ecliptic comets were produced by the Sun as the result of RF of the Sun's DM Core 4.57 Byr ago. Nearly isotropic comets were produced by Giant Planets with different directions of their rotational axes (which are, in fact, "Failed stars") as the result of RF of their DM cores. In our view, Random Explosive Volcanic RF of the Sun's DM Core looks like a Firework of DM cores of satellite objects at the same time so that the

direction of the sum of satellites angular momentum coincides with an angular momentum of the Sun. There are no preferences of directions of satellites vs random rotation direction.

DM cores of satellite objects can be any size from 1 m to thousands of km. Satellites are rocky or icy bodies as the result of the self-annihilation of DMPs inside of their cores with a density of cores $\gtrsim 10^3 \, kg/m^3$. All compositions of asteroids and comets are "Homemade". Formation of all objects in SS has a good explanation.

Tunguska Superbolide. In case when the density of DM cores of satellite is $< 10^3 \, kg/m^3$ the self-annihilation process is not efficient. Then, there is a possibility of stable DM Bolides, which are the analog of Ball Lightnings (BLs) with much larger internal energy. The range of Weak interaction for particles DMF1 is:

$$R_{DMF1}^W = 0.88 \times 10^{-8} \, m$$

and a calculated minimum particles concentration is:

$$n_{DMF1} = 1.47 \times 10^{24} \, m^{-3} \, .$$

Considering the rest energy of DMF1:

$$E_{DMF1} = 1.315 \, TeV = 2.11 \times 10^{-7} \, J \, ,$$

we can calculate the minimum energy density of DM core:

$$\rho_{DMF1} = 3.1 \times 10^{17} \, J/m^3$$

that is equivalent to the mass density of 3.44 kg/m^3 that is not enough for the efficient self-annihilation.

Tunguska Superbolide (TSB) had the calculated maximum energy

$$E_{TSB} = 1.26 \times 10^{17} \, J$$

It means that a maximum of its DM core volume is about 0.4 m^3. The calculated maximum diameter of the Superbolide is:

$$D_{TSB} = 82.2 \, m$$

In our view, Weak interaction of particles DMF1 provides the integrity of the Superbolide core and Super-weak interaction – of the Superbolide itself [19]. TSB was a stable MO before entering the Earth's atmosphere.

Superbolide entered the Earth's atmosphere from outer space traveling at speed of 27 km/s. Despite moving through the rarified Earth's atmosphere the immense speed at which It traveled rapidly compressed the air in its path. The Superbolide then experienced ram pressure. As the air in front of It is compressed its temperature quickly rises. Ram pressure and the very high temperatures caused increasing of the DM cores' energy density up to the critical value of $\sim 10^3 \, kg/m^3$ when the efficient self-annihilation of particles DMF1 took place and DM core exploded.

Summary:

- Tunguska Event explained by the huge atmospheric explosion of the Superbolide, which was a stable DM Macroobject before entering the Earth's atmosphere. It was a Bubble with the core made of the DM particles DMF1 (1.3 TeV) with a mass density of 3.44 kg/m^3 that is not enough for the efficient self-annihilation. The introduced Weak interaction provides an integrity of the DM core, and the Super-Weak interaction provides the integrity of the Bubble itself. Ram pressure and the very high temperatures in the Bubble are the cause Superbolide exploded;

- Ecliptic comets were produced by Sun as a result of RF of the Sun's DM Core 4.57 Byr ago. Nearly isotropic comets were produced by Giant Planets with different directions of their rotational axes as a result of RF of their DM cores. All compositions of asteroids and comets were produced by self-annihilating DM cores.

6. Explained Problems [20]

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 Volcanic Rotational Fission of Overspinning DM Supercluster's Cores;
- **Hubble Tension** explained by observations of Galaxies, which belong to different Superclusters. The value of Hubble's parameter 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 Intergalactic plasma;
- **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 DM 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 coronal heating. Plasma particles (electrons, protons, multicharged ions) are so far apart that plasma temperature in the usual sense is not very meaningful. Plasma is the result of the self-annihilation of DMPs. The Solar corona made up of DMPs resembles a honeycomb filled with plasma;
- **Cores of Sun and Earth** rotate 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;
- **Internal Heating of Gravitationally-Rounded Objects** in SS is explained by DMRs inside of all MOs fueled by DMPs. Internal Heating is due to DMPs self-annihilation;
- **Diversity of Gravitationally-Rounded Objects** in SS is explained by DMRs 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;
- **Plutonium-244** with half-life of 80 million years exists in Nature. It is not produced by the nuclear fuel cycle, because it needs very high neutron flux environments. Any Pu-244 present in the Earth's crust should have decayed by now. In WUM, all chemical products of the Earth including isotopes K-40, U-238, Th-232, and Pu-244, are produced within the Earth as the result of DMF1 self-annihilation. They arrive in the Crust of the Earth due to convection currents in the mantle carrying heat and isotopes from the interior to the planet's surface;
- **Expanding Earth** hypothesis asserts that the position and relative movement of continents is at least partially due to the volume of Earth increasing. In WUM, the Earth's DM core absorbs new DMPs, and its size is increasing in time $\propto \tau^{1/2}$. Hence, there is an expansion of DM core, and its surface (the Upper mantle with Crust) is stretching. Due to DMPs self-annihilation, new chemical elements are created inside of the Upper mantle with Crust. As the result, the relative movement of continents is happening;
- **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, 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 Microwave Background Radiation** is due to thermodynamic equilibrium of photons with Intergalactic plasma;
- **Unidentified Infrared Discrete Emission Bands** with peaks 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm explained by the 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 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 BLs according to the proposed model of them. Once we master the 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.

7. Conclusion

Hypersphere World-Universe Model is consistent with all Concepts of the World. The Model successfully describes primary cosmological parameters and their relationships. WUM allows for precise calculation of values that were only measured experimentally earlier and makes verifiable predictions. The remarkable agreement of calculated values with the observational data gives us considerable confidence in the Model.

Great experimental results and observations achieved by Astronomy in last decades should be analyzed through the prism of WUM. Considering the JWST discoveries, successes of WUM, and 86 years of Dirac's proposals, it is high time to make a Paradigm Shift for Cosmology and Classical Physics.

Acknowledgements

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