

Hypersphere World-Universe Model: Digest of Presentations

John Chappell Natural Philosophy Society

Vladimir S. Netchitailo

netchitailov@gmail.com

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Abstract

Today, a growing number of researchers share a sense of stagnation in the field of Physics. In many ways, this situation is reminiscent of the late 19th century when it was widely believed that the body of Physics was nearly complete. It may be an opportune moment to propose new fundamental models that are not only simpler than the current state of the art but also open up new areas of research. Several ideas presented in this Digest are not new, and I do not claim credit for them. In fact, many of these ideas, originally proposed by classical scientists, are revisited here with fresh insights. This Digest aims to describe the World by unifying and simplifying existing models and results in Cosmology into a single coherent picture.

Hypersphere World–Universe Model (WUM) is proposed as an alternative to the prevailing Big Bang Model. The main advantage of WUM is its elimination of the “Initial Singularity” and “Inflation,” providing explanations for many unresolved problems in Cosmology. This Digest offers an overview of WUM covering the period from 2013 to 2024 (detailed in Part 2 and the referenced materials) and explores various themes of the World (Presentations 1 – 8). It concludes a series of articles published in the [Journal of High Energy Physics, Gravitation and Cosmology](#) [3]-[39]. Many results obtained in those articles are referenced here without full justification; interested readers are encouraged to consult the referenced articles (Part 2) for more details. WUM is a classical model and should be described using 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. These simple interactions occur at the microscopic level, while their collective outcomes can be observed at the macroscopic level. WUM introduces classical notions from the moment the first ensemble of particles was created $\cong 10^{-18}$ s.

Classical Physics is dealing with ensembles of quantum objects!

54 Years in Physics

Abstract

I am a Doctor of Sciences in Physics. I belong to the school of physicists established by Alexander Prokhorov–Nobel Prize Laureate in Physics. I am a Laser Physicist by education, having published over 200 papers. I graduated from Moscow Institute of Physics and Technology with High Honors in 1970. I am eternally grateful to Academician A. M. Prokhorov and Prof. A. A. Manenkov, whose influence on my scientific life has been decisive.

24 years ago, I developed an interest in Cosmology. I have been elaborating a model I dubbed World- Universe Model (WUM) and published a series of articles in the [Journal of High Energy Physics, Gravitation and 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.

In my view, there is a principal difference between Physics and Mathematics. I am convinced that Physics cannot exist without Mathematics, but Mathematics must not replace Physics. I absolutely agree with John von Neumann who said: *“The sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct, which, with addition of certain verbal interpretations describes observed phenomena. The justification of such a mathematical construct is solely and precisely that it is expected to work”*.

1. Introduction

In 1964, I enrolled in Moscow Institute of Physics and Technology (MIPT). During the final exam on General Physics, I have prepared a report on “*Why is the sky blue?*” theme, based on “*Light Scattering*” by L. Mandelstam. That report has started my life-long interest in Optics.

In 1967, I have started working at Lebedev Physical Institute in the Oscillations Laboratory headed by A. Prokhorov. In 1970, I have graduated MIPT with M.Sc. and defended a thesis on “*Nonlinear Scattering of Light in Inhomogeneous Media*” subject. In 1974, I have obtained my PhD. Topic of the thesis: “*Investigation of Light Scattering and Laser-Induced Damage in Crystals and Glasses*”. In 1987, Doctor of Sciences dissertation “*Interaction of High-Power Laser Radiation with Optical Polymers*” was defended at the Institute of General Physics headed by A. Prokhorov.

I have been fascinated with new and original ideas in Physics. For instance, Light Scattering in the Sky based on **Fluctuations** in the atmosphere (proposed by L. Mandelstam) went against the prevailing idea of Light Scattering on **Molecules** in the atmosphere (by the great physicist Lord Rayleigh). It is worth noting that eventually Lord Rayleigh accepted the idea of L. Mandelstam!

Below, I would like to share with you some **Original Ideas**, which I proposed and developed in 54 years of my scientific life.

2. Interaction of High-Power Laser Radiation with Crystals and Glasses

2.1. Nonlinear Light Scattering

My investigations of a Laser-Induced Damage (LID) in transparent dielectrics showed that there is a correlation between Light Scattering (LS) in materials and their LID threshold: the higher the intensity of LS, the lower the LID threshold. It follows that different kinds of inclusions and defects inside of materials are responsible for LS and LID. Then, LS can be used as a Measure of optical purity of transparent dielectrics.

Moreover, at laser radiation intensities I close to LID threshold I_1 : $I \lesssim I_1$ the nonlinear dependence of LS intensity from I was observed [1]. To explain this new effect, I developed a theory of nonlinear LS in inhomogeneous media considering various mechanisms of the nonlinearity of the refractive index: optical Kerr effect, heating, and electrostriction. Analytical expressions for LS intensity and spectrum were obtained. The observed experimental results were in good agreement with the developed theory [2], [3].

2.2. Thermal Instability as a Principal Concept in Laser-Induced Damage

The concept of thermal instability in LID associated with absorbing inclusions has been proposed in our work [4]. It has been shown that the heating of inclusions produced by laser radiation has a character of thermal explosion at intensities higher than some critical value. Local temperature in the inclusion region turns out to be very high ($\sim 10^4 K$), giving rise to thermal radiation with a maximum intensity in the UV spectral region. This radiation being absorbed by the ambient matrix leads to its photoionization. As a result, absorption spreads to the inclusion vicinity, which was primarily transparent. A detailed analysis of these processes [5] indicates that laser heating of the inclusions and accompanying photoionization encourage thermal instability in the matrix, resulting in the catastrophic macrodamage. The critical intensity that gives rise to this instability corresponds to I_1 . The observed experimental results were in good agreement with the developed theory [4], [5].

It is worth noting that our work went against the prevailing linear theory of laser-induced thermal destruction of transparent dielectrics containing absorbing inclusions. That theory explained the role of foreign inclusions in LID of transparent materials, but it could not explain the catastrophic behavior of a process of macrodamage development inside of transparent dielectrics under laser irradiation.

The obtained scientific results were used in the development of the High-Power Laser Optics made of extremely pure Fused Silica and became a chapter in Cycle of Research on "*Laser-Induced Damage to Glasses*" that won the prestigious Komsomol award in 1979.

3. Interaction of High-Power Laser Radiation with Optical Polymers

3.1. Accumulation Effect in Laser-Induced Damage

At the laser radiation intensity below the critical value for the thermal instability, catastrophic macrodamage does not appear after a single shot, but irreversible changes may occur in both the inclusion itself and the ambient matrix. Various kinds of defects, e. g. color centers and radicals, can be produced under laser irradiation, which might absorb the radiation of successive laser pulses. In other words, the effective area and absorption coefficient of both the inclusion and ambient matrix increase from pulse to pulse. This accumulation of irreversible changes may produce thermal instability and catastrophic damage at some critical pulse N that depends on the laser radiation intensity I_N below single-shot LID threshold I_1 . The above consideration indicates that the thermal instability is the key process in both the single-shot and multi-shot LID, and that multi-shot damage characteristics can be determined by laser-induced defect generation mechanism.

In 1976, a novel method to study multi-shot LID in Optical Materials at $I < I_1$ was proposed. The method was based on the observation of nonlinear light scattering from a region of interaction of laser radiation and optical materials. Utilizing this method, we discovered the accumulation of irreversible changes in the bulk of sapphire crystals and a number of glasses upon their exposure to a series of consecutive laser shots of Ruby laser with $I < I_1$. The accumulation process results in the appearance of visible damage after the last shot [6].

The accumulation effect in LID of polymer materials has been revealed and studied in our works (see, for example [7-16]). This effect is the most pronounced one in standard transparent polymers. It can be observed at $I \lesssim 0.01 I_1$. This fact was the main obstacle for applications of polymer materials in Laser Optics. The targeted experiments carried out with different optical polymers allowed us to reveal their LID mechanism and propose efficient methods to increase a multi-shot damage threshold I_N up to I_1 . We achieved this result by physical modification of polymer matrix with Low-Molecular Additives (LMAs), which significantly change viscoelastic properties of polymer matrix and provide efficient vibrational cross-relaxation from macromolecules to LMAs.

3.2. Role of Viscoelastic Properties of Polymers in Laser-Induced Damage

It is well known that polymers possess a thermal expansion coefficient that is much larger than the coefficient of crystals and glasses. At the same time, the tensile strength of polymers is much smaller than tensile strength of crystals and glasses. Our theoretical analysis of combined equations of thermal conductivity and elasticity for an absorbing inclusion in polymer matrix shows that the tensile strength of the matrix due to thermoelastic stresses can be achieved at the inclusion heating about 100 °C. It means that I_1 of transparent polymers should be much smaller than I_1 of crystals and glasses that is observed in experiments. On the other hand, LID mechanism of polymers should depend on their viscoelastic properties. The influence of thermoelastic stresses can be taken down by changing viscoelastic properties of the matrix towards reducing brittleness and increasing plasticity, which can be attained by introducing plasticizers in polymers. Using this approach, we were able to increase I_N of transparent polymers in our experiments [7], [8], [9].

3.3. Decisive Role of Vibrational Cross-Relaxation

A very promising method of defect formation inhibition is physical modification of a material by introducing special additives which reduce the lifetime of energy states of macromolecules from which the defects (e. g. radicals in polymers) are developed. I proposed this method in 1982 [10], and it has been realized for optical polymers and turned out to be exclusively effective and resulted in a more than 100-fold increase of I_N [11- 16]. This result is intriguing since radicals in polymers are developing from vibrational states of macromolecules, which should have long enough relaxation time that the transfer of vibrational energy from the macromolecule to LMA could be efficient. This idea went against the commonly accepted opinion that the relaxation of vibrational excited states in Solid States has a very high rate and consequently very short relaxation time.

The proposed method based on vibrational cross-relaxation is very efficient not only for LID of optical polymers. We found significant (more than 10-fold) increase of polymers' resistance to the high-power UV and gamma-radiation [17] and lasing and bleachable dyes impregnated into laser-resistant polymer matrix [18], [19]. In our opinion, this method can be used for increasing thermostability, photostability, gamma-stability, and laser-stability of different materials used in various applications.

Based on the conducted research the following results were obtained:

- New class of physically modified optical polymers for laser applications was created [20];
- Efficient plastic-host dye lasers are used for medical applications [21];
- Polymer laser optical elements were developed for various applications [22];
- Doctor of Sciences dissertation "*Interaction of High-Power Laser Radiation with Optical Polymers*" was defended at the Institute of General Physics headed by A. Prokhorov in 1987.

4. Solid State Physics

4.1. Diffusion of Point Defects Participating in Solid-Phase Reactions

A problem of trap diffusion, which is a diffusion of first component in solid states participating in solid-phase chemical reaction with motionless second component, is solved in our work [23]. Time dependences of the reaction front displacement X_f and its steepness $(dC/dX)_f$ are determined analytically for $N_0 \ll C_0$ and numerically for all relations of N_0 and C_0 (N_0 and C_0 are the equilibrium concentration of the first component and the initial concentration of the second component, respectively). It was shown that the displacement of the chemical reaction front obeys the diffusion law having a coefficient of the reaction-front displacement D_f equals to: $D_f = 2 \frac{N_0}{C_0} D$.

This coefficient in its essence is considerably different from a diffusion coefficient of the first component D by the fact that D_f depends on the ratio of N_0 and C_0 concentrations. In literature, this fact has not been given proper consideration, and D_f parameter has been identified with D . Dependence of X_f vs. C_0 and time t is confirmed for oxygen annealing of corundum crystals doped with titanium by measurements for the $Ti^{3+} \rightarrow Ti^{4+}$ transition-front displacement as a function of initial concentration of Ti^{3+} , partial oxygen pressure, and temperature [23].

Analogous experiments were performed with optical polymers impregnated with bleachable dye for Nd-laser: we observed a front of the discolored dye as a result of dye molecules reaction with radicals caused by oxygen penetrating into the polymer matrix from the environment. Based on the obtained results we conclude that, for high stability of dyes in polymers during long-term use and storage, the polymer synthesis must be performed under conditions that exclude radical products [19].

4.2. Nonlinear Diffusion of Low-Molecular Additives in Polymers

Low-Molecular Additives (LMAs) introduced into polymers can evaporate from the polymer matrix during long-term operation and storage. Then, to create polymer materials that are efficient in high-power lasers for a long time, it was necessary to find out what requirements should be met by LMAs that prevent evaporation. Previously, it was believed that LMAs introduced into a polymer should have the lowest possible diffusion coefficient. This conclusion was based on solving the diffusion equation provided that the diffusion coefficient of LMA: $D_0 = const$ and that the evaporation coefficient of LMA from the polymer surface is quite large, such that the Bio parameter: $Bi > 100$. It was shown that the relative change in the sample mass $p(t)$ due to evaporation of LMA depends on D_0 and changes over time as $p(t) \sim \sqrt{t}$.

However, in practice, both of these conditions are usually not met: D_0 depends on concentration of LMA in the polymer and the Bio parameter: $Bi < 100$. For an adequate description of the evaporation of LMA from the polymer, it is necessary to solve the nonlinear diffusion equation considering the finiteness of Bi . The theoretical analysis of this equation showed that at the initial stage $p(t)$ is determined by an evaporation coefficient from a polymer surface and $p(t) \sim t$ [24]. These results are principally different from the commonly accepted results described above.

Study of the characteristics of the nonlinear diffusion of LMAs in polymers was carried out by using samples of PMMA with 20% ethanol, which is a readily-evaporated plasticizer. Experiments have shown that the evaporation of ethanol at the initial stage is well described by our formula. The calculated value of $Bi = 33.6$ confirms our nonlinear approach to this physical phenomenon. Thus, LMA introduced into the polymer for ensuring high-power laser resistance for a long time, must have the lowest possible evaporation coefficient from the polymer surface [24].

4.3. Theory of Free Volume in Polymers

The free volume concept in condensed media proves to be very useful for a theoretical description of many processes occurring in liquids and polymers: LMA diffusion, thermal conductivity, thermal expansion that is mostly due to higher free volume. Williams, Landell, and Ferri developed the theory of polymer viscoelastic properties on the basis of the Doolittle empirical equation, involving viscosity $\eta(T)$ and specific free volume $f(T)$ through the following ratio: $\eta(T) = a \exp[b/f(T)]$, where a and b are constants. Assuming that $b = 1$ and a free volume depends linearly on T : $f(T) \sim T$, they obtained a free volume at glass transition temperature T_g : $f(T_g) = 0.025$. It worth noting that the experimentally observed dependence is $f(T) \sim T^{3/2}$ and $f(T_g) = 0.1 - 0.15$, if calculated using the data on compressibility [25]. All of this suggests that the polymer free volume theory is far from complete and requires new concepts to be developed.

Usually, all theories of condensed media are based on structural elements, which behave like oscillators with small value of damping factor when affected by periodic force. It is a good approach to the medium, like crystal. We propose to consider the medium, like polymer, which consists of structural elements, which behave like oscillator with very high value of damping factor. We named them "relaxators". Their motion is aperiodic (non-oscillatory) with the minimal relaxation time. Then, we consider fluctuations of relaxators in the medium. According to the fluctuation-dissipation theorem, involving the fluctuation of physical quantities and the dissipative properties of the system externally affected, we find the mean-square value of the fluctuation deviation of the relaxator from the equilibrium [25]: $X^2 = k_B T / K$, where k_B is Boltzmann constant and K is the elasticity coefficient. The mean-square value of the fluctuation volume of relaxator v_f is proportional to: $v_f \sim X \times Y \times Z \sim T^{3/2}$ and the free volume of polymer V_f equals to: $N_f = N v_f$, where N is the number of relaxators. It follows that $V_f \sim T^{3/2}$ is in agreement with experimental results. The calculated value of $f(T_g) = 0.124$ is in good agreement with the experimentally measured values using the data on compressibility [25].

4.4. Theory of Relaxation Spectra

Relaxation spectroscopy refers to the response of a material to any external periodic force field (electric, magnetic, mechanical, etc.) and the observation of the absorption of the energy of the field, depending on its frequency, which is the relaxation spectrum. The absorption bands in the relaxation spectrum are due to the resonant interaction of the force field with the structural elements of the material and characterize their molecular mobility at a fixed temperature. Using the principle of temperature-time equivalence, the temperature dependence of the absorption of field energy at fixed frequencies are usually studied, since this method is more easily realized experimentally.

Before my work, the relaxation spectra were described on the basis of the following concept of the thermal motion of structural elements. The motion occurs through the transition of elements from one equilibrium position to an adjacent one. The rate of such a transition depends on the height of the potential barrier U separating two neighboring equilibria, the volume of the element v_c and temperature T . Each element is characterized by the relaxation time, which, according to Frenkel and Eyring, has the following temperature dependence [26]: $\tau = B \exp(U/k_B T)$, where B is the preexponential coefficient associated with the activation entropy. However, attempts to apply this dependence in the analysis of relaxation spectra in a number of cases lead to the values of the parameters U and B , which have no physical meaning. Thus, in PMMA for the α -process, values $U = 228 \text{ kcal/mol}$ and $B = 10^{-130} \text{ s}$ are obtained and a strong dependence of U from T is observed.

In contrast with the "Energetical" approach considered above, in which τ is determined by U , we developed a "Spatial" approach, in which τ is determined by a specific available fluctuation volume f_d . In our work [25], we developed a model of a condensed medium, consisting of structural elements – relaxators. The thermal movement of relaxators occurs as follows: due to thermal fluctuations, the elements are removed from the equilibrium positions and return to them after relaxation time $\tau = \tau_0 \exp(f_d^{-1})$, where τ_0 is the minimum relaxation time. The value of f_d is based on the fluctuation-dissipation theorem [25]. The calculated theoretical results for β -process in PMMA are in good agreement with the experimentally found values [26].

The obtained scientific results were used in the development of the Polymer Passive Q-switch for the Laser Range Finder that was working for 11 years in the temperature range: ± 50 °C and stored for 13 years in the range: ± 65 °C.

5. Hypersphere World-Universe Model

Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.

Albert Einstein

5.1. Essence of World-Universe Model (WUM)

The main ideas of WUM, which is an alternative to Big Bang model, are as follows [27-33]:

- 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*⁾ in the 4D Nucleus of the World. Dark Matter (DM) Particles (DMPs) carry new DM into the World. Luminous Matter is byproduct of DMPs self-annihilation. DM plays a central role in creation and evolution of all Macroobjects;
- WUM introduces Dark Epoch (spanning from the Beginning of the World for 0.45 billion years) and Luminous Epoch (ever since, 13.77 billion years). Transition from Dark Epoch to Luminous Epoch is due to Explosive Rotational Fission of Overspinning DM Supercluster's Cores and self-annihilation of DMPs;
- The Medium of the World, consisting of protons, electrons, photons, neutrinos, and 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 Albert 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 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;
- Macroobjects (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 Dark Matter Reactors fueled by DMPs. All chemical elements, compositions, substances, rocks, *etc.* are produced by MOs themselves as the result of DMPs self-annihilation in Dark Matter Reactors;

*⁾ In 2024, I introduced new term – Universe-Created (UC) Matter instead of Dark (D) Matter, which is "dark", **optically invisible**, when observed by telescopes only. UC Matter radiates **Gamma rays**, which emitted by nuclei, as a result of the self-annihilation of UC particles with rest energies spanning eighteen orders of magnitude (see Presentations 5-8).

- 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 Gravitational parameter G that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly.
- Fermi Bubbles are DMPs' clouds containing uniformly distributed Dark Matter Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays;
- 3D Finite Boundless World (Hypersphere of 4D Nucleus) presents Patchwork Quilt of various main Luminous Superclusters ($\geq 10^3$), which emerged in different places of the World at different Cosmological times. The Medium of the World, consisting of protons, electrons, photons, neutrinos, and dark matter particles, is Homogeneous and Isotropic. Distribution of MOs is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous;
- 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;
- The manuscript "*Review Article: Cosmology and Classical Physics*" [31] is a synthesis of my approach to Cosmology and the article "*JWST Discoveries—Confirmation of World-Universe Model Predictions*" [32] is a quintessence of WUM.

5.2. Predictions of WUM

In 2013, WUM revealed a self-consistent set of time-varying values of Primary Cosmological Parameters of the World: Gravitational parameter, Hubble's parameter, Age of the World, Temperature of Microwave Background Radiation, and concentration of Intergalactic plasma. Based on the inter-connectivity of these parameters, WUM solved the Missing Baryon problem and predicted the values of the following Cosmological parameters: gravitational G , concentration of Intergalactic plasma, and the minimum energy of photons [27], which were experimentally confirmed in 2015 – 2018. "*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*" (Nobel Prize in Physics 2020) made by R. Genzel and A. Ghez confirms one of the most important predictions of WUM in 2013: "*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*" [27].

Conclusion

WUM does not attempt to explain all available cosmological data, as that is an impossible feat for any one manuscript. 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 new Physics proposed by Paul Dirac in 1937. The Model should be developed into a well-elaborated theory by entire physical community.

Acknowledgements

I am grateful to Top Co-Authors: A. S. Belichenko, D. A. Gromov, Yu. K. Danileiko, K. M. Dyumaev, V. Ya. Khaimov-Mal'kov, A. A. Manenkov, A. P. Maslyukov, G. A. Matyushin, A. M. Prokhorov, A. S. Tsaprilov. Special thanks to my wife Anna Netchitailo for the idea of writing this CV and our son Ilya Netchitailo who has reviewed and edited this work.

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24 Years in Cosmology

Abstract

Hypersphere World-Universe Model (WUM) solves a number of physical problems in contemporary Cosmology and Astrophysics through Dark Matter*^j) Particles and their interactions: **Angular Momentum problem** in birth and subsequent evolution of Galaxies and Extrasolar systems – how do they obtain it; **Hubble Tension** – disagreement in the values of Hubble’s constant obtained by various teams; **Fermi Bubbles** – two large structures in gamma-rays and X-rays above and below Galactic Centre; **Coronal Heating problem** in solar physics – temperature of Sun's corona exceeding that of photosphere by millions of degrees; **Cores of Sun and Earth** rotating faster than their surfaces; **Diversity of Gravitationally-Rounded Objects** in Solar system and their **Internal Heat**; **Lightning Initiation problem** – electric fields observed inside thunderstorms are not sufficient to initiate sparks; **Terrestrial Gamma-Ray Flashes** – bursts of high energy gamma rays emanating from the Earth. The Model solves **Missing Baryon problem** related to the fact that the observed amount of baryonic matter did not match theoretical predictions. WUM reveals **Inter-Connectivity** of Primary Cosmological Parameters and calculates their values, which are in good agreement with the latest results of their measurements.

In 2013, Model predicted the values of the following Cosmological parameters: Gravitational, Hubble’s, Concentration of Intergalactic plasma, and the Minimum energy of photons, which were experimentally confirmed in 2015 – 2021. The Nobel Prize in Physics 2020 “*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*” confirmed one of the most important predictions of WUM: “*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*”. WUM is, in fact, a Paradigm Shift for Cosmology. According to WUM, Superclusters are the principal objects of the World. Macroobjects (MOs) form from the top (Superclusters) down to Galaxies and Extrasolar systems in parallel around different Cores made up of different Dark Matter Particles. Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing.

1. Introduction

I am a Doctor of Sciences in Physics. I belong to the school of physicists established by A. Prokhorov–Nobel Prize Laureate in Physics. I am a Laser Physicist by education, having published over 200 papers.

24 years ago, I developed an interest in Cosmology and have been elaborating a model I dubbed [World-Universe Model](#) (WUM) for 13 years, and then in 2013, I uploaded my first papers on viXra and later, in 2015, published a series of articles in [Journal of High Energy Physics, Gravitation and Cosmology](#). An article [Hypersphere World-Universe Model](#) is a synthesis of my approach to Cosmology. An article [Paradigm Shift in Cosmology](#) is an essence of my view of the World.

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

*^j) In 2024, I introduced new term – Universe-Created (UC) Matter instead of Dark (D) Matter, which is “dark”, **optically invisible**, when observed by telescopes only. UC Matter radiates **Gamma rays**, which emitted by nuclei, as a result of the self-annihilation of UC particles with rest energies spanning eighteen orders of magnitude (see Presentations 5-8).

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

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

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

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

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

WUM follows the idea of the continuous creation of matter by the additive mechanism, albeit introducing a different mechanism of matter creation. The Mechanism of continuous creation of matter was the main issue of WUM during its development for 24 years.

There were a few principal steps in the development of WUM:

- In **2013**: 3D World is a Hubble's Sphere (that is a Black Hole in frames of General Relativity). The World is expanding in the Universe without limit with the speed equal to the gravitodynamic constant c . The Universe serves as an unlimited source of energy that the World is consuming as it grows. Predicted values of cosmological parameters: Gravitational, Hubble's, Concentration of Intergalactic plasma, and Minimum energy of photons were confirmed experimentally in 2015 – 2021. The Nobel Prize in Physics 2020 “*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*” confirmed one of the most important predictions of WUM: “*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*” [1], [2].
- In **2015-2016**: 5D Model is aligned with the theoretical framework developed by P. S. Wesson, albeit assigning a new physical meaning to the fifth coordinate. It is associated with the total energy of the Medium of the World [3]-[6].
- In **2016-2018**: The finite 3D World is a Hypersphere that is the surface of a 4D Nucleus. All points of the hypersphere are equivalent; there are no preferred centers or boundary of the World. In 1854, G. Riemann proposed a hypersphere as a model of a finite universe. WUM follows this idea, albeit proposing

that the World is stretching and filled with the Medium of the World consisting of stable elementary particles. The surface of the hypersphere is created continuously in a process analogous to sublimation. The creation of matter is happening homogeneously in all points of the hypersphere World and is a direct consequence of 4D Nucleus expansion [7]-[12].

- In **2019-2020**: To be consistent with the Law of Conservation of Angular Momentum, the Model developed a New Physics of the World [13]-[18]:
 - Principal objects of the World are overspinning Dark Matter (DM) Cores of Superclusters, which were created during Dark Epoch. It started at the Beginning of the World and lasted for about 0.45 billion years;
 - Luminous Epoch spans from 0.45 billion years up to the present Epoch (during 13.77 billion years). The transition from Dark Epoch to Luminous Epoch was the result of the Rotational Fission of DM Cores of Superclusters and self-annihilation of Dark Matter Particles (DMPs);
 - Luminous Matter is a byproduct of DMPs self-annihilation;
- In **2021-2022**: The synthesis of my approach to Cosmology and the essence of my view of the World are formulated in articles [19]-[29];
- In **2023-2024**: Decisive Role of Gravitational Parameter and Angular Momentum, Dark Stars and Galaxies, Cosmic Bubbles and Tunguska Event are discussed in articles [30]-[39]. I introduced a new term – Universe-Created (UC) Matter instead of Dark (D) Matter, which is “dark”, optically invisible, when is observed by telescopes only. UC Matter radiates **Gamma rays**, which emitted by nuclei, as a result of self-annihilation of UC particles with rest energies, covering eighteen orders of magnitude from $5.3 \mu eV$ up to $1.3 TeV$.

Below, I would like to share with you some Original Ideas, which I proposed and developed in 24 years of my scientific life in Cosmology.

2. Hubble’s Sphere World-Universe Model

WUM is based on three primary assumptions:

- The World is finite and is expanding inside the Universe with speed equal to the gravitodynamic constant c . The Universe is an unlimited Source of Energy that continuously enters into the World from the boundary;
- Medium of the World, consisting of protons, electrons, photons, neutrinos, and DMPs, is an active agent in all physical phenomena in the World;
- Two fundamental parameters in various rational exponents define all macro- and micro- features of the World: Fine-Structure constant α , and dimensionless quantity Q . While α is constant, Q increases with time, and is, in fact, a measure of the Size and the Age of the World.

In 2013, WUM revealed a self-consistent set of time-varying values of Primary Cosmological Parameters of the World: Gravitation parameter, Hubble’s parameter, Temperature of Microwave Background Radiation, Age of the World, and concentration of Intergalactic plasma. Based on the inter-connectivity of these parameters, WUM solved the Missing Baryon problem and predicted the values of following Cosmological parameters: gravitation, Hubble’s, concentration of Intergalactic plasma, and the minimum energy of photons, which were experimentally confirmed in 2015 – 2021. “*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*” (Nobel Prize in Physics 2020) made by R. Genzel and A. Ghez confirms one of the most important predictions of WUM in 2013: “*Macroobjects of the World have cores made up of discussed DM particles. Other particles, including DM and baryonic matter, form shells surrounding cores*”.

Based on the Inter-connectivity of Primary Cosmological Parameters, WUM explains experimental data accumulated in the field of Cosmology over the last decades: the Age of the World; Critical energy density; Temperatures of the Cosmic microwave background radiation and Peak of the Far-infrared radiation of cosmic dust; Hubble’s parameter and Maximum stellar mass. Additionally, the Model explains “Pioneer Anomaly”; resolves paradoxes like “Matter – Antimatter Asymmetry” and “Faint Young Sun”. WUM makes predictions pertaining to rest energies of DMPs and neutrinos; proposes new types of particle interactions (Super Weak and Extremely Weak). The Model suggests introducing a new fundamental parameter Q in the CODATA internationally recommended values for calculating time-varying parameters of the World.

3. 5D World-Universe Model

5D Space-Time-Energy World–Universe Model is a unified model of the World built around the concept of the Medium. WUM utilizes the following principles:

- **Time-varying gravitational parameter.** This hypothesis was proposed by P. Dirac in 1937.
- **Continuous creation of matter.** F. Hoyle and J. V. Narlikar in 1964 offered an explanation for the appearance of new matter by postulating the existence of what they dubbed the “creation field”. P. Dirac in 1974 discussed continuous creation of matter by additive/multiplicative mechanism.
- **The World is a 3-sphere** that is a surface of a 4-ball Nucleus of the World. The 4-ball is expanding in the fourth spatial dimension of the Nucleus and its surface, the 3-sphere, is likewise expanding. The total surface energy of the 4-ball is increasing as it expands, thus creating new matter in the 3-sphere World.
- **Supremacy of matter** was 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*”.
- **The World consists** of the Medium (protons, electrons, photons, neutrinos, and DMPs) and Macroobjects (Superclusters, Galaxies, Extrasolar systems) made of these particles.
- **Mach’s principle.** A very general statement of Mach’s principle is: “*Local physical laws are determined by the large-scale structure of the universe*”.
- **Fifth dimension.** In 1983, P. S. Wesson suggested that a fifth dimension might be associated with rest mass via $x^4 = Gm/c^2 \propto t$.

5D WUM aligns with the theoretical framework developed by P. S. Wesson, albeit assigning a new physical meaning to the fifth coordinate. In WUM, the fifth dimension is associated with the total energy of the Medium of the World, and the gravitomagnetic parameter of the Medium that serves as the dimension-transposing parameter.

J. M. Overduin and P. S. Wesson postulated that “*Metrics which do not depend on $4x$ can give rise only to induced matter composed of massless photons; while those which depend on $4x$ give back equations of state for fluids composed of massive particles*”. WUM supplies the fluid that they have predicted: it is, in fact, the Medium of the World.

According to WUM, an empty space does not exist; instead, the World is filled with the Medium that consists of massive particles. The inter-galactic voids discussed by astronomers are, in fact, examples of the Medium in its purest. Consequently, the Medium of the World as described by WUM can serve as further evidence in favor of the fifth-dimensional view of the World.

4. Hypersphere World-Universe Model

Hypersphere WUM is based on the following Principal Points:

- The World was started by a Fluctuation in the Eternal Universe, and the Nucleus of the World, which is a four dimensional 4-ball, was born.

- The 3D World is the Hypersphere that is the surface of a 4-ball Nucleus. Hence, the World is curved in the fourth spatial dimension of the Nucleus.
- The 4-ball is expanding in the Universe, and its surface, the hypersphere, is likewise stretching so that the radius of the 4-ball R is increasing with speed c that is the gravitodynamic constant.
- The World consists of the Medium and MOs. The Medium consists of stable elementary particles with lifetimes longer than the Age of the World: protons, electrons, photons, neutrinos, and DMPs. The Medium is not Aether; it is a mixture of elementary particles. The energy density of the Medium is $2/3$ of the total energy density in all cosmological times.
- Superclusters, Galaxies, Extrasolar systems are made of these particles. The energy density of MOs is $1/3$ of the total energy density in all cosmological times. There are no empty space and dark energy in WUM.
- Time, Space and Gravitation are emergent phenomena and have no separate existence from Matter. In WUM, they are closely connected with the Impedance (Wave Resistance), the Gravitomagnetic parameter, and Energy density of the Medium, respectively.
- Two Fundamental parameters in various rational exponents define all macro- and micro- features of the World: Fine-structure constant α and dimensionless Quantity Q . While α is constant, Q increases in time, and is in fact a measure of the Worlds' curvature in the fourth spatial dimension of the Nucleus.
- WUM holds that there exist relations between all Q -dependent parameters: Newtonian parameter of gravitation and Hubble's parameter; Critical energy density and Fermi coupling parameter; Temperatures of the Microwave Background Radiation and Peak of Far-Infrared Background Radiation. The calculated values of these parameters are in good agreement with the latest results of their measurements.
- A black-body spectrum of a cosmic Microwave Background Radiation is due to thermodynamic equilibrium of photons with low density Intergalactic plasma.
- DM consists of 5 different particles: Neutralinos, WIMPs, DIRACs, ELOPs, and sterile neutrinos, and has a relative energy density of about 24%.
- All MOs of the World (superclusters, galaxies, extrasolar systems) possess the following properties: their Cores are made up of DMPs; they contain other particles, including DM and baryonic matter, in shells surrounding the Cores. Self-annihilation of DMPs can give rise to any combination of gamma-ray lines.
- Nucleosynthesis of all elements occurs inside stars during their evolution. Stellar nucleosynthesis theory should be enhanced to account for self-annihilation of heavy DMPs (WIMPs, Neutralinos) inside of the Stars' Cores.
- MOs form from top (superclusters) down to galaxies and extrasolar systems in parallel around different Cores made of different DMPs. Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing.
- Assuming an Eternal Universe, the numbers of cosmological structures on all levels will increase – new superclusters will form; existing superclusters will obtain new galaxies; new stars will be born inside existing galaxies; sizes of individual stars will increase, etc. The temperature of the Medium of the World will asymptotically approach absolute zero.

5. Hypersphere World-Universe Model. New Physics

The angular momentum problem is one of the most critical problems in BBM. Standard Cosmology cannot explain how Galaxies and Extra Solar systems obtained their substantial orbital and rotational

angular momenta, and why the orbital momentum of Jupiter is considerably larger than the rotational momentum of the Sun. WUM is the only cosmological model in existence that is consistent with the Law of Conservation of Angular Momentum. To be consistent with this Fundamental Law, WUM discusses in detail the Beginning of the World. The Model introduces Dark Epoch (spanning from Beginning of the World for 0.45 Byr) when only DM Macroobjects existed, and Luminous Epoch (ever since for 13.77 Byr).

WUM solves a number of physical problems in Standard Cosmology and Astrophysics through DMPs and their interactions: Angular Momentum problem in birth and subsequent evolution of Galaxies and Extrasolar systems; Fermi Bubbles—two large structures in gamma-rays and X-rays above and below Galactic center; Coronal Heating problem in solar physics—temperature of Sun’s corona exceeding that of photosphere by millions of degrees; Cores of Sun and Earth rotating faster than their surfaces; Diversity of Gravitationally-Rounded objects in Solar system and their Internal Heating. Model makes predictions pertaining to rest energies of DMPs, proposes new type of their interactions. WUM reveals Inter-Connectivity of Primary Cosmological Parameters and calculates their values, which are in good agreement with the latest results of their measurements.

The main ideas of WUM are as follows:

- The Finite World is a 3D Hypersphere of the 4D Nucleus of the World, which is 4D ball expanding in the fourth spatial dimension of the Nucleus. 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 DM in the 4D Nucleus of the World. 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 MOs;
- WUM introduces Dark Epoch (spanning from the Beginning of the World for 0.45 billion years) and Luminous Epoch (ever since, 13.77 billion years). Transition from Dark Epoch to Luminous Epoch is due to Rotational Fission of Overspinning DM Supercluster’s Cores and self-annihilation of DMPs;
- The Medium of the World, consisting of protons, electrons, photons, neutrinos, and 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 Albert Einstein: *“When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter”*;
- 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 **Dark Matter Reactors** fueled by DMPs. All chemical elements, compositions, substances, rocks, etc. are produced by MOs themselves as the result of DMPs self-annihilation;
- WUM is the only cosmological model in existence that is consistent with the Fundamental Law of Conservation of Angular Momentum;
- WUM revealed the Inter-Connectivity of all Primary Cosmological Parameters;
- Fermi Bubbles are DMPs’ clouds containing uniformly distributed Dark Matter Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays;
- 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.

6. New Cosmology – Third Revolution in Physics

Dirac's themes were the unity and beauty of Nature. He identified three revolutions in modern physics – Relativity, Quantum Mechanics and Cosmology. In his opinion: *“The new cosmology will probably turn out to be philosophically even more revolutionary than relativity or the quantum theory, perhaps looking forward to the current bonanza in cosmology, where precise observations on some of the most distant objects in the universe are shedding light on the nature of reality, on the nature of matter and on the most advanced quantum theories”*.

In 1937, P. Dirac proposed: the Large Number Hypothesis and the Hypothesis of the variable gravitational “constant”; and later added the notion of continuous creation of Matter in the World. The developed Hypersphere WUM follows these ideas, albeit introducing a different mechanism of matter creation.

WUM is based on the following Primary Points:

- **The Beginning.** The World was started by a fluctuation in the Eternal Universe, and the Nucleus of the World, which is a 4D ball, was born. An extrapolated Nucleus radius at the Beginning was equal to the basic unit of size a . The World is a finite 3D Hypersphere that is the surface of the 4D Nucleus. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World. The extrapolated energy density of the World at the Beginning was four orders of magnitude smaller than the nuclear energy density.
- **Expansion.** The 4D Nucleus is expanding along the fourth spatial dimension of the Nucleus and its surface, the 3D Hypersphere, is likewise expanding so that the radius of the Nucleus is increasing with speed c that is the gravitodynamic constant.
- **Creation of Matter.** The surface of the Nucleus is created in a process analogous to sublimation. 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, the Matter-Antimatter asymmetry problem discussed in literature does not arise. Creation of Matter is a direct consequence of expansion.
- **Content of the World.** The World consists of the Medium and MOs. Total energy density of the World equals to the critical energy density throughout the World's evolution. The energy density of the Medium is 2/3 of the total energy density and Macroobjects (Superclusters, Galaxies, and Extrasolar systems)– 1/3 in all cosmological times. The relative energy density of Dark Matter Fermion (DMF) particles DMF4 is about 68.8%, self-annihilating DMPs (DMF1, DMF2, DMF3, DIRACs, and ELOPs) – about 24%, and Ordinary Particles (protons, electrons, photons, and neutrinos) – about 7.2% .
- **Two Fundamental Parameters** in various rational exponents define all micro- and macro-features of the World: dimensionless Rydberg constant α and time-varying Quantity Q . The World's energy density is proportional to Q^{-1} in all cosmological times. Particles relative energy densities are proportional to $\alpha \cdot Q$ in the present epoch equals to: $Q = 0.759972 \times 10^{40}$.
- **Supremacy of Matter.** Time, Space and Gravitation have no separate existence from Matter. They are closely connected with the Impedance, Gravitomagnetic parameter, and Energy density of the Medium, respectively.
- **Inter-Connectivity of Primary Cosmological Parameters.** WUM reveals the Inter-Connectivity of them and calculates their values, which are in good agreement with the latest results of their measurements.

- WUM introduces **Dark Epoch** (spanning from the Beginning of the World for 0.45 billion years) and **Luminous Epoch** (ever since, 13.77 billion years). Transition from Dark Epoch to Luminous Epoch is due to the **Rotational Fission** of Overspinning DM Supercluster's Cores and self-annihilation of DMPs.
- **Macroobjects Shell Model.** MOs of the World possess the following properties: their Cores are made up of DMPs; they contain other particles, including DMPs and Ordinary Particles, in shells surrounding the Cores. Introduced **Weak Interaction** between DMPs provides integrity of all shells. Self-annihilation of DMPs can give rise to any combination of gamma-ray lines.
- **Macroobjects Formation and Evolution.** MOs form from superclusters down to galaxies and extrasolar systems in parallel around different Cores made up of different DMPs. Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing. Assuming an Eternal Universe, the numbers of cosmological structures on all levels will increase – new superclusters will form; existing clusters will obtain new galaxies; new stars will be born inside existing galaxies; sizes of individual stars will increase, etc. The temperature of the Medium will asymptotically approach absolute zero.
- **Nucleosynthesis** of elements occurs inside of MOs during their evolution. Stellar nucleosynthesis theory should be enhanced to account for self-annihilation of DMPs inside of Stars.
- **Black-body spectrum of the Cosmic Microwave Background Radiation** is due to thermodynamic equilibrium of photons with Intergalactic plasma.
- **Milky Way Galaxy** is a Disk Bubble whose boundary with Intergalactic Medium has a surface energy density σ_0 (a basic surface energy density σ_0 equals to: $\sigma_0 = hc/a^3$, where h is Planck constant). The Disk Bubble contains Intragalactic Medium and (100 – 400) billion Stars.
- **Dark Matter Fermi Bubbles** are stable clouds of DMPs containing uniformly distributed Dark Matter Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays. Proposed **Weak interaction** between particles DMF3 (3.7 keV) provides integrity of Fermi Bubbles.
- **Extrasolar systems.** The boundary between Extrasolar systems and Intragalactic Medium has a surface energy density σ_0 . This bubble-like region of space, which surrounds the Sun, is named Heliosphere that is continuously inflated by Solar jets, known as the Solar wind.
- **Solar system.** A detailed analysis of the Solar system shows that the overspinning DM Core of the Sun can give birth to DM planetary cores, and they can generate DM cores of moons through the Rotational Fission mechanism.
- **Solar Corona, Geocorona and Planetary Coronas** made up of DMPs resemble honeycombs filled with plasma particles (electrons, protons, and multi-charged 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.
- **Dark Matter Reactors.** Macroobjects' cores are essentially Dark Matter Reactors fueled by DMPs. All chemical elements, compositions, radiations are produced by MOs themselves as the result of DMPs self-annihilation in their DM cores.

7. Paradigm Shift in Cosmology

The most important Concepts for any Cosmological model are as follows: universality of physical laws; cosmological principle (homogeneous and isotropic universe); Space, Time, and Gravitation; speed of light in vacuum; structure and content of the World; dark matter and ordinary matter; origin of matter

(singularity or continuous creation); Law of Conservation of Angular Momentum; Primary Cosmological Parameters; Four Pillars of Standard Cosmology – expansion of Universe, nucleosynthesis of light elements, formation of large-scale structures, origin of cosmic background radiation. The performed analysis shows that Standard Cosmology fails to account for these concepts. The most intriguing result is that there was no **Initial Singularity**: all galaxies are gravitationally bound with their Superclusters.

Hypersphere WUM is, in fact, a Paradigm Shift in Cosmology. According to WUM, Superclusters are the principal objects of the World. Macroobjects form from the top (Superclusters) down to Galaxies and Extrasolar systems in parallel around different Cores made up of different DMPs. Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing.

The latest observations of the World [25]:

- *Galaxies congregate in clusters and along filaments, and are missing from large regions referred to as voids;*
- *Most cosmological structures in the universe spin. The generation of angular momentum across these scales is poorly understood;*
- *The discovery of a giant, almost symmetrical arc of galaxies – the Giant Arc – spanning 3.3 billion light years at a distance of more than 9.2 billion light years away, which is difficult to explain in current models of the Universe.*

can be explained in frames of the developed **WUM** only:

- *“Galaxies **do not** congregate in clusters and along filaments”. On the contrary, Cosmic Web that is “networks of structure that are interconnected with no clear boundaries” is the result of the Rotational Fission of DM Cores of neighbor Superclusters;*
- *“Generation of angular momentum across these scales” provide DM Cores of Superclusters through the Rotational Fission mechanism;*
- *“Spinning cylindrical tendrils of matter hundreds of millions of light-years across” are the result of spiral jets of galaxies generated by DM Cores of Superclusters with internal rotation;*
- *The Giant Arc is the result of the intersection of the Galaxies’ jets generated by the neighbor DM Cores of Superclusters;*
- *Cosmological Principal is valid for the Homogeneous and Isotropic Medium of the World with 2/3 of the total Matter. The distribution of Macroobjects with 1/3 of the total Matter is Inhomogeneous and Anisotropic, and therefore, the Cosmological Principal is not viable;*
- *The main conjecture of Standard Cosmology: “Projecting galaxy trajectories backwards in time means that they converge to the **Initial Singularity** at $t=0$ that is an infinite energy density state” is wrong because all Galaxies are gravitationally bound with their Superclusters.*

Hubble Tension that is the disagreement in the values of the Hubble’s constant H_0 obtained by the various teams is due to the observations of Galaxies belonging to different Superclusters. According to WUM, the value of H depends on the cosmological time: $H = \tau^{-1}$. It means that the **value of H should be measured based on Cosmic Microwave Background only**. The calculated value of Hubble’s constant in 2013: $H_0 = 68.733 \text{ km/s Mpc}$ is in excellent agreement with the most recent measured value in 2021: $H_0 = 68.7 \pm 1.3 \text{ km/s Mpc}$ using only Cosmic Microwave Background data [25].

8. Conclusion

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 new Physics proposed by Paul Dirac in 1937. The Model should be developed into a well-elaborated theory by the entire physical community. In our view, great experimental results and observations achieved by Astronomy in the last decades should be analyzed through the prism of a New Paradigm – Hypersphere World-Universe Model.

Acknowledgements

I am always grateful to Academician A. M. Prokhorov and Prof. A. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father Paul Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to Nicola Tesla who was a genius. Special thanks to my son Ilya Netchitailo who helped me refine the Model and improve its understanding.

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These Collected Articles will be used as References in the following Presentations 1 – 8.

Presentation 1. Medium of the World [1][2][7][9][11][26][31]

Introduction

I received a Master of Science degree from Moscow Institute of Physics and Technology, a PhD in Quantum Electronics from Moscow Lebedev Physical Institute, and a Doctor of Sciences in Laser Physics from Moscow Institute of General Physics. I have published over 200 papers, including forty articles co-authored by A. Prokhorov (Nobel Laureate in Physics 1964).

Since 2001, I have been developing a Model that I dubbed a World-Universe Model (WUM), which is, in fact, a Paradigm Shift for Cosmology and Classical Physics. WUM has had a good record of accomplishment on predicting Cosmological parameters with a high degree of accuracy.

In 2014, J. Luo, who was one of the organizers of the CODATA Royal Society Meeting in London, said: *The Newtonian gravitational constant G holds an important place in physics. Though there have been about 300 measurements of G since the first laboratory measurement by Cavendish over 200 years ago, its measurement precision is the worst among all the fundamental physics constants.*

In 2013, based on the revealed Inter-Connectivity of Cosmological parameters, WUM calculated a value of G and recommended it to all members of the Meeting. No breakthrough in G measurements has been achieved in 2014. Nevertheless, in 2015 CODATA recommended a value of G that is x3 more accurate than the previous one. In 2018, the recommendation improved further. Since 2013, the relative standard uncertainty of G measurements reduced x6. It was the very first success of WUM!

Physics and Mathematics

Physics is an Experimental Science. In my opinion, there is a principal difference between Physics and Mathematics. I am convinced that Physics cannot exist without Mathematics, but Mathematics must not replace Physics. It is exactly what has happened for the last 100 years.

I absolutely agree with J. von Neumann who said: *The sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct, which, with addition of certain verbal interpretations describes observed phenomena. The justification of such a mathematical construct is solely and precisely that it is expected to work.* In my view, the value of models is not only describing observed phenomena but making verifiable predictions and setting up targeted experiments based on the obtained experimental results.

Classical Physics

Emergent Phenomena. By definition, emergent phenomenon is a property that is the result of simple interactions that work cooperatively to create a more complex interaction. They occur at microscopic level, and the collective result can be observed at a macroscopic level. For example, temperature of the ideal gas (that is a classical notion) is proportional to the average kinetic energy of its particles. The “temperature” knows nothing about movement of each particle, and particles have kinetic energies only. They have no idea about the “temperature”. **Classical Physics is dealing with ensembles of quantum objects!**

Electrodynamic constant. In 1857, W. Weber and R. Kohlrausch determined that there was a quantity related to electricity and magnetism, *the ratio of the absolute electrostatic unit of charge to the absolute electromagnetic unit of charge* and determined that it should have units of velocity. In modern language, it is an electrodynamic constant c according to a formula $c = 1/\sqrt{\mu_0\epsilon_0}$, where μ_0 is the permeability of free

space and ϵ_0 is the permittivity of free space. They measured this ratio by an experiment which involved charging and discharging the Leyden jar and measuring the magnetic force from the discharge current and found the value of $c = 3.107 \times 10^8 \text{ m/s}$ remarkably close to the speed of light, which had recently been measured at $v_{light} = 3.15 \times 10^8 \text{ m/s}$ by H. Fizeau in 1849. However, Weber and Kohlrausch did not make the connection to the speed of light.

Maxwell's equations were published by J. C. Maxwell in 1861. He calculated the **velocity of electromagnetic waves** from the value of the electrodynamic constant c measured by Weber and Kohlrausch and noticed that the calculated velocity was very close to the speed of light measured by Fizeau. 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**. According to Maxwell's equations, electromagnetic waves in any bulk material travel at a velocity v_{EM} that is a function of permeability μ_M and permittivity ϵ_M of a material:

$$v_{EM} = 1/\sqrt{\mu_M \epsilon_M}$$

where $\mu_M = \mu_r \mu_0$, $\epsilon_M = \epsilon_r \epsilon_0$, and μ_r and ϵ_r are the relative permeability and permittivity of the material, respectively. Then, the velocity of electromagnetic waves equals to:

$$v_{EM} = c/\sqrt{\mu_r \epsilon_r}$$

In case of vacuum: $\mu_r = \epsilon_r = 1$, the velocity $v_{EM} = c$. In case of Outer space: $\mu_r = 1 + 5.4 \times 10^{-10} > 1$, the velocity $v_{EM} < c$. It follows that there is no miracle in the maximum value of the velocity of electromagnetic waves that equals to the value of the Electrodynamic constant c ! In any bulk material the velocity $v_{EM} < c$.

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

Unique properties of Aether were discussed by J. McCullagh in 1846 who proposed a theory of a **rotationally elastic medium**. The potential energy of deformation in such a medium depends only on the rotation of the volume elements and not on their compression or general distortion. This theory produces equations analogous to Maxwell's equations. Aether with these properties can transmit transverse waves. He was a genius!

It turned out that abandoning of the Luminiferous Aether in 1905 by Special Relativity 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 who said: *The constitution of the ether, if it ever would be discovered, will be found to be quite different from any thing 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.*

The Friedmann equations were derived in 1922 from Einstein's field equations for a Friedmann-Lemaitre-Robertson-Walker metric and a **perfect fluid**. Eather exists or not in General Relativity?

In later years there have been classical physicists who advocated for the existence of Aether:

- Nicola Tesla declared in 1937: *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 "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. There are no Luminiferous Aether and Vacuum. The Model introduces the Medium that is composed of stable elementary particles: protons, electrons, photons, neutrinos, and dark matter particles.*¹ **Medium is a Savior of Classical Physics! Don't throw the baby out with the bathwater.**

Hypersphere World-Universe Model

Primary Assumptions

WUM is based on the following primary assumptions:

- World is a Finite Boundless 3D Hypersphere of a 4D Nucleus of the World which is expanding along the fourth spatial dimension of the Nucleus with speed equals to the gravitodynamic constant c . The 3D World is curved in the fourth spatial dimension;
- Eternal Universe is a Creator of Dark Matter (DM), which is continuously created in the Nucleus of the World. Ordinary Matter is a byproduct of DM particles self-annihilation;
- Medium of the World is an active agent in all physical phenomena in the World;
- Two fundamental parameters in various rational exponents define all macro and micro features of the World: dimensionless Rydberg constant $\alpha = (2aR_\infty)^{1/3}$ (where R_∞ is a Rydberg constant and $a = 1.7705641 \times 10^{-14} m$ is a basic size unit) and dimensionless time-varying quantity Q that is, in fact, the Dirac's Large Number. α now named the Fine-structure constant.

Principal Points

WUM is based on the following principal points:

- **Beginning.** The World was started by a Fluctuation in the Eternal Universe, and the Nucleus of the World, which is a 4D ball, was born. An extrapolated Nucleus radius at the Beginning was equal to the basic size unit of a . The extrapolated energy density of the World at the Beginning ($Q = 1$) was four orders of magnitude smaller than the nuclear energy density. The World is a Finite Boundless 3D Hypersphere that is the surface of the 4D Nucleus. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World.
- **Stretching of the World.** The 4D Nucleus is expanding along Its fourth spatial dimension so that the radius of the Nucleus R is increasing with speed c that is the gravitodynamic constant. Its surface, the 3D Hypersphere, is evenly stretched. The stretching of the Hypersphere World can be understood through the analogy with expanding 3D balloon: imagine an ant residing on a seemingly two-dimensional surface of a balloon. As the balloon is blown up, its radius increases, and its surface grows. The distance between any two points on the surface increases. The ant sees her world expand but does not observe a preferred center. Unbeknown to ants, the center is not located on the surface, but instead, is removed along the inaccessible third dimension. It is in the center of the balloon. What does the balloon expand into? It expands in perpendicular "down/up" direction that is inaccessible to perception, and therefore from the surface of the balloon. One cannot point out the direction of the expansion.

Likewise, 3D Hypersphere World expands along the imperceptible fourth dimension. The Center of the World is in the center of 4D Nucleus, in that very inaccessible fourth dimension. We do not know that our 3D space is curved. But we know that it is stretching without center of stretching. According to WUM, all

*¹ In 2024, I introduced new term – Universe-Created (UC) Matter instead of Dark (D) Matter, which is "dark", **optically invisible**, when observed by telescopes only. UC Matter radiates **Gamma rays**, which emitted by nuclei, as a result of the self-annihilation of UC particles with rest energies spanning eighteen orders of magnitude (see Presentations 5-8).

parameters of the World depending on Q , which is a ratio of radius R to a : $Q = R/a$ are a manifestation of the Worlds' curvature in the fourth spatial dimension.

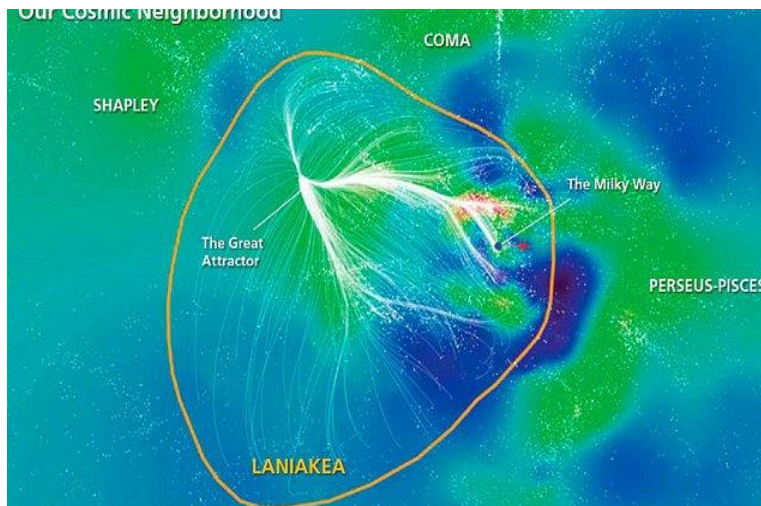
- **Creation of Matter.** The surface of Nucleus is created in a process analogous to sublimation. Continuous creation of matter is the result of this process. Sublimation is a well-known process that happens when surfaces are intrinsically more energetically favorable than the bulk of a material, and hence there is a driving force for surfaces to be created. The Universe is responsible for the creation of DM in 4D Nucleus of the World. Dark Matter Particles (DMPs) carry new DM into the World. Ordinary Matter is a byproduct of DMPs self-annihilation. By analogy with 3D ball, which has a 2D spherical surface (that has surface energy), we can imagine that 3D Hypersphere World has a "Surface Energy" of 4D Nucleus. The growth of the surface of 4D Nucleus means the increase of the World's so named "Surface Energy". Proposed 4D process is responsible for 4D Nucleus Expansion, 3D World Stretching, Creation of Matter, and Arrow of Time. It constitutes the **Main Hypothesis of WUM**. In my 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 Nucleus 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 the Nucleus expansion. Creation of DM occurs homogeneously in all points of the Hypersphere World.
- **Content of the World.** The World consists of the Medium and Macroobjects. Total energy density of the World equals to the critical energy density throughout the World's evolution. The energy density of the Medium is $2/3$ of the total energy density and Macroobjects (Superclusters, Galaxies, Extrasolar Systems, *etc.*) – $1/3$ in all cosmological times. The relative energy density of DMPs is about 92.8% and Ordinary particles (protons, electrons, photons, and neutrinos) – about 4.8% in the Medium of the World and 2.4% in Macroobjects.
- **Rotational Fission.** The mechanism that can provide Angular Momenta to Macroobjects is a Rotational Fission of overspinning (surface speed at equator exceeding escape velocity) Prime Objects. From the point of view of Fission model, the prime object is transferring some of its rotational angular momentum to orbital and rotational momenta of satellites. It follows that the rotational momentum of the prime object should exceed the orbital momentum of its satellite. In WUM, prime objects are DM Cores of Superclusters, which must accumulate tremendous rotational angular momenta before the Birth of a Luminous World. It means that it must be some long enough time in the history of the World, which we named "Dark Epoch".
- **Dark Epoch** is spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr (for Laniakea Supercluster that is a home to Milky Way galaxy) when only DM Macroobjects existed.
- **Luminous Epoch** is lasting ever since for 13.77 Byr when Luminous Macroobjects emerged due to the **Explosive Volcanic Rotational Fission** of Overspinning DM Supercluster's Cores and self-annihilation of DMPs.
- **Macroobjects Shell Model.** Macroobjects of the World possess the following properties: their Cores are made up of DMPs; they contain other particles, including DMPs and Ordinary particles, in shells surrounding the Cores. Introduced **Weak Interaction** between DMPs and Ordinary particles provides integrity of all shells.
- **Dark Matter Reactors.** Macroobjects' cores are essentially DM Reactors fueled by DMPs. All chemical elements, compositions, radiations are produced by Macroobjects themselves as the result of DMPs self-annihilation in their DM cores. **Nucleosynthesis of all elements** occurs inside of Macroobjects during their evolution.

- **Macroobjects Formation.** Superclusters are the principal objects of the World. Macroobjects (Superclusters, Galaxies, and Extrasolar systems) form in parallel around different Cores made up of different DMPs. 3D Finite Boundless World presents a Patchwork Quilt of different Luminous Superclusters ($\geq 10^3$), which emerged in different places of the World at different Cosmological times. The distribution of Macroobjects in the World is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous. Macrostructures of the World form from the top (superclusters) down to galaxies, extrasolar systems, planets, and moons.
- **Macroobjects Evolution.** Formation of galaxies and stars is not a process that concluded ages ago; instead, it is ongoing. Assuming the Eternal Universe, numbers of cosmological structures on all levels will increase; new superclusters will form; existing clusters will obtain new galaxies; new stars will be born inside existing galaxies; sizes of individual stars will increase.

Most Direct Observational Evidence of Validity of WUM

1) Microwave Background Radiation (MBR), Intergalactic Plasma, and Far-Infrared Background Radiation speak in favor of existence of the **Medium of the World**.

2) Laniakea Supercluster with binding mass $\sim 10^{17} M_{\odot}$ is home to the Milky Way galaxy and $\sim 10^5$ other nearby galaxies, which did not start their movement from Initial Singularity. The neighboring superclusters are Shapley, Coma, and Perseus-Pisces. Distance from the Earth to the Centre of the Laniakea Supercluster is $\sim 250 Mly$.



3) Milky Way is gravitationally bounded with the Virgo Supercluster and has an orbital **Angular Momentum** calculated based on distance of $65 Mly$ from the Virgo Supercluster and the orbital speed of $\sim 400 km s^{-1}$, which far exceeds rotational **Angular Momentum** of Milky Way.

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

5) Astronomers discovered the most distant galaxy HD1 that is $13.5 Bly$ away and a candidate galaxy F200DB-045, which is $13.7 Bly$ away.

As the conclusion: Medium of the World, Dark Matter, and Angular Momentum are main **Three Pillars** of WUM. The described picture of the World is, in fact, a Paradigm Shift for Cosmology.

Medium of the World

WUM introduces the Medium of the World, which consists of stable elementary particles with lifetimes longer than the age of the World: protons, electrons, photons, neutrinos, and DMPs. The Medium is Homogeneous and Isotropic. The **existence of the Medium is a principal point of WUM**. There are no Luminiferous Aether, Perfect fluid, and Vacuum in WUM. Inter-galactic voids discussed by astronomers are, in fact, examples of the Medium in its purest. MBR is part of the Medium; it then follows that the **Medium is the absolute frame of reference**. Relative to MBR rest frame the Milky Way (MW) galaxy and the Sun are moving with the speed of 552 and 370 $km s^{-1}$, respectively.

Time, Space and Gravitation are closely connected with 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*. There is no Medium - there is Nothing!

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

Principal Role of Maxwell's Equations

Maxwell's Equations form the foundation of classical Electrodynamics and Gravitomagnetism. The value of Maxwell's Equations 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 **Gravitomagnetism considers not only interactions between masses but also between mass currents**.

G. Ludwig in a paper "Galactic rotation curve and dark matter according to gravitomagnetism" published in 2021, 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. The effects attributed to dark matter can be simply explained by the gravitomagnetic field produced by the mass currents*.

The explanation of galactic rotation curves made by G. Ludwig is in good agreement with WUM.

Directly Measured Cosmological Parameters

There are only two directly measured Cosmological parameters: the Gravitational parameter G and the Temperature of the Cosmic MBR T_{MBR} . In 2018, Q. Li, *et al.* experimentally measured the most accurate values of G using two independent methods:

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

$$G(2) = 6.674484 \times 10^{-11} m^3 kg^{-1} s^{-2} \text{ (11.61 ppm)}$$

which are in excellent agreement with the value of $G = 6.67420 \times 10^{-11} m^3 kg^{-1} s^{-2}$ predicted by WUM in 2013. In 2009, D. J. Fixsen measured the value of MBR temperature T_{MBR} :

$$T_{MBR} = 2.725181 K \text{ (30 ppm)}$$

It means that the most accurate parameter is G , and all other Cosmological parameters could be, in principal, calculated based on the value of G with the same accuracy.

Thanks to the revealed by WUM Inter-Connectivity of Cosmological parameters, we show that G that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly. We will discuss it beneath.

Inter-Connectivity of Cosmological Parameters

The constancy of universe fundamental constants, including G , is now commonly accepted, although has never been firmly established as a fact. A commonly held opinion states that gravity has no established relation to other fundamental forces, so it does not appear possible to calculate it from other constants that can be measured more accurately, as is done in other areas of physics.

WUM holds that there indeed exist relations between all Cosmological parameters that depend on dimensionless time-varying quantity Q (we will discuss it below) that is a measure of the Size R and Age A_τ of the World according to the equation:

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

where t_0 is a basic time unit: $t_0 = a/c$. Q in the present epoch equals to: $Q = 0.759972 \times 10^{40}$.

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 and τ is a cosmological time) and an energy density of a spherical surface that equals to a basic unit of surface energy density: $\sigma_0 = hc/a^3$ (where h is the Planck constant). 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 Its average energy density ρ_W :

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

that is inversely proportional to R ($\rho_0 = hc/a^4$ is a basic unit of energy density).

Critical Energy Density

The principal idea of WUM is that the energy density of the World ρ_W equals to a critical energy density ρ_{cr} , which can be found by considering a sphere of radius R_M and an 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 energy density, a Hubble velocity: $v_H = H \times R_M$ ($H = c/R$ is the Hubble's parameter) equals to the escape velocity:

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

which gives an equation for the critical energy density ρ_{cr} :

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

We emphasize that ρ_{cr} can be found by the Hubble's law only. We do not need General Relativity for this. This equation can be rewritten as follow:

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

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

Gravitational Parameter G and Dirac Large Number Q

Considering equations, which we discussed before, we can find the following equation for G :

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

An average value of Gravitational parameter G_{av} of experimentally measured values by Q. Li, *et al.*

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

allows us to calculate the value of Q_{av} based on the value of G_{av} :

$$Q_{av} = \frac{a^2 c^4}{8\pi h c} \times G_{av}^{-1} = 0.759944 \times 10^{40}$$

Below, we will use this value of Q_{av} for the calculation of all Cosmological parameters.

Intergalactic Plasma

In WUM, the World consists of stable elementary particles. Protons with mass m_p and electrons with mass m_e have identical concentrations: $n_p = n_e$. According to Plasma Physics, Intergalactic plasma consisting of protons and electrons has plasma frequency ω_{pl} according to the equation:

$$\omega_{pl}^2 = \frac{4\pi n_e e^2}{4\pi \epsilon_0 m_e} = 2n_e a c^2$$

We substitute the following equation $\omega_{pl}^2 = \frac{m_e}{m_p} (2\pi \nu_0 \times Q^{-1/2})^2$ into the equation above (where ν_0 is a basic frequency unit $\nu_0 = c/a$) and calculate concentrations n_p and n_e :

$$n_p = n_e = \frac{2\pi^2 m_e}{a^3 m_p} \times Q^{-1} = 0.255 m^{-3}$$

$\rho_p = n_p E_p$ is the energy density of protons in the Medium. The relative energy density of protons in the Medium Ω_p is then the ratio of ρ_p/ρ_{cr} , which equals to:

$$\Omega_p = 2\pi^2 \alpha / 3 = 4.8\%$$

According to WUM, the relative energy density of baryons in Macroobjects Ω_{MO} is:

$$\Omega_{MO} = 0.5 \Omega_p = \pi^2 \alpha / 3 = 2.4\%$$

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

The dispersion measure and redshift, conducted by E. F. Keane, *et al.* in 2016, provide the measurement of the cosmic density of ionized baryons in the intergalactic medium Ω_{IGM} that equals to:

$$\Omega_{IGM} = 4.9 \pm 1.3\%$$

that is in excellent agreement with the predicted by WUM in 2013 value of $\Omega_p = 4.8\%$. Using the equation for electrons' concentration n_e , we calculated the value of photons' time delay:

$$\Delta t_{ph}^{cal} = 2.189 \times \left(\frac{\nu}{1GHz}\right)^{-2}$$

which is in good agreement with experimentally measured value by E. F. Keane, *et al.* :

$$\Delta t_{ph}^{exp} = 2.438 \times \left(\frac{\nu}{1GHz}\right)^{-2}$$

Minimum Energy of Photons

Analysis of Intergalactic plasma shows that the value of the lowest plasma frequency ν_{min} is :

$$\nu_{min} = \nu_0 \left(\frac{m_e}{m_p}\right)^{1/2} \times Q^{-1/2} = 4.53228 \text{ Hz}$$

Photons with energy smaller than $E_{ph} = h\nu_{min}$ cannot propagate in plasma. Thus $h\nu_{min}$ is the smallest amount of energy a photon may possess, which equals to the value:

$$E_{ph} = \left(\frac{m_e}{m_p}\right)^{1/2} E_0 \times Q^{-1/2} = 1.87433 \times 10^{-14} \text{ eV}$$

The above value, predicted by WUM in 2013, is in good agreement with the value obtained by L. Bonetti, *et al.* in 2017:

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

Origin of Cosmic Microwave Background Radiation (MBR)

According to the standard Big Bang Model, the photons that existed at the time of photon decoupling (380,000 years after Big Bang) 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 the classical notion. Photons, which are quantum objects, have only four-momenta. They do not have wavelengths. By definition, *Black-body radiation is the thermal electromagnetic radiation within or surrounding a body in thermodynamic equilibrium with its environment.* In WUM, the black-body spectrum of MBR is due to thermodynamic equilibrium of photons with Intergalactic plasma, the existence of which is experimentally proved by Fast Radio Bursts. It explains why MBR is a perfect black-body radiation.

$\rho_e = n_e E_e$ is the energy density of electrons in the Medium. We assume that the energy density of MBR ρ_{MBR} equals to twice the value of ρ_e (due to two polarizations of photons) and consider the Stefan-Boltzmann law:

$$\rho_{MBR} = 2\rho_e = 4\pi^2 \alpha \frac{m_e}{m_p} \rho_0 \times Q^{-1} = \frac{8\pi^5}{15} \frac{k_B^4}{(hc)^3} T_{MBR}^4$$

where k_B is the Boltzmann constant. The calculated value of T_{MBR} is:

$$T_{MBR} = \frac{E_0}{k_B} \left(\frac{15\alpha m_e}{2\pi^3 m_p}\right)^{1/4} \times Q^{-1/4} = 2.725245 \text{ K}$$

Thus calculated value of T_{MBR} is in excellent agreement with experimentally measured value of $2.72548 \pm 0.00057 \text{ K}$ by D. J. Fixsen in 2009.

Let us proceed to calculate the value of T_{MBR} at different Ages of the World A_τ (see **Table 1**).

Table 1. The value of T_{MBR} at different Ages of the World.

Age	T_{MBR}
0.45 Byr (Beginning of Luminous Epoch)	6.47747 K
9.6 Byr (Birth of Solar System)	3.01403 K
14.22 Byr (Present Epoch)	2.725245 K

Observe that all macroobjects – galaxies, stars, planets, moons – have arisen in the cold World. Our Solar system, for instance, was created when the temperature of MBR was about 3 K. Therefore, any Model describing creation of Macroobjects must hold true in the cold World conditions.

Far-Infrared Background Radiation

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

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

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

Primary Cosmological Parameters

According to WUM, the following parameters of the World depend on Q :

- Newtonian parameter of gravitation G : $G = \frac{a^2 c^4}{8\pi h c} \times Q^{-1}$
- Hubble's parameter H : $H = \frac{c}{a} \times Q^{-1}$
- Age of the World A_τ : $A_\tau = \frac{a}{c} \times Q$
- The Worlds' Radius of curvature R : $R = a \times Q$
- Critical energy density ρ_{cr} : $\rho_{cr} = 3 \frac{hc}{a^4} \times Q^{-1}$
- Concentration of Intergalactic plasma n_{IGP} : $n_{IGP} = \frac{2\pi^2 m_e}{a^3 m_p} \times Q^{-1}$
- Minimum energy of photons E_{ph} : $E_{ph} = \left(\frac{m_e}{m_p}\right)^{1/2} E_0 \times Q^{-1/2}$
- Temperature of MBR T_{MBR} : $T_{MBR} = \frac{E_0}{k_B} \left(\frac{15\alpha m_e}{2\pi^3 m_p}\right)^{1/4} \times Q^{-1/4}$
- Temperature of Far-Infrared Background Radiation peak T_{FIRB} :

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

In frames of WUM, all these Cosmological parameters are a manifestation of the Worlds' curvature in the fourth spatial dimension. They can be calculated based on experimentally measured value of G_{av} and Q_{av} as we showed above.

Hubble's Parameter and Age of the World

The most important parameters in Cosmology are the Hubble's parameter H_0 and Age of the World A_τ , which we can calculate by the following equations:

$$H_0 = \frac{8\pi h c}{a^3 c^3} \times G_{av} = 68.73 \text{ km s}^{-1} \text{ Mpc}^{-1}$$

$$A_\tau = \frac{1}{H_0} = \frac{a^3 c^3}{8\pi h c} \times G_{av}^{-1} = 14.22 \text{ Byr}$$

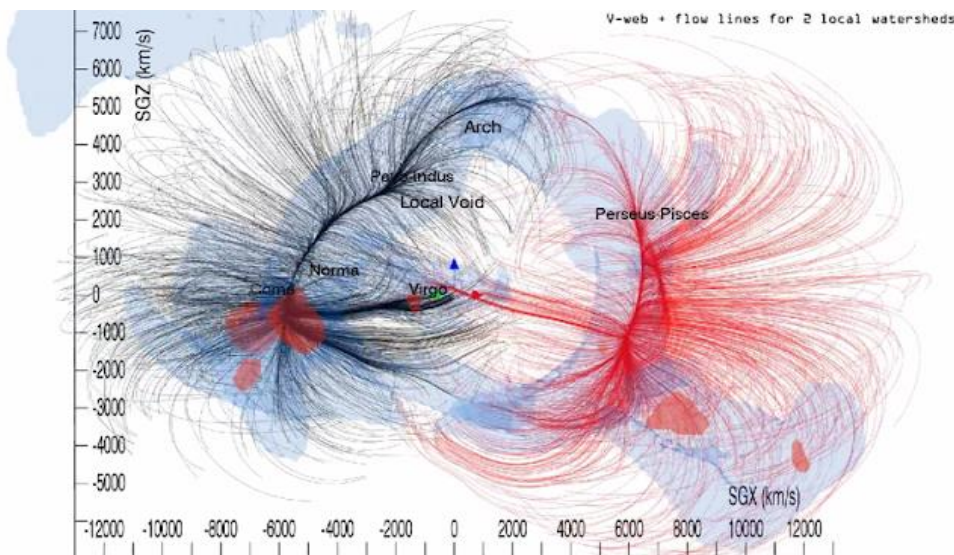
We emphasize that the Hubble's parameter H_0 and absolute Age of the World A_τ are determined by the experimentally measured value of G_{av} !

Hubble Tension

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

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

- Hubble's law in Standard Cosmology is valid for the Big Bang Model only when all galaxies start their movement from a single point named "Initial Singularity" that is not the case in WUM. The main conjecture of BBM: "*Projecting galaxy trajectories backwards in time means that they converge to the Initial Singularity at $t=0$ that is an infinite energy density state*" is wrong because all Galaxies are gravitationally bound with their Superclusters;
- In WUM, the 3D Finite Boundless World presents a Patchwork Quilt of different Luminous Superclusters, which emerged at different places and Cosmological times;
- The redshift of the Centre of the Laniakea Supercluster is 0.0708. But it does not mean that it is moving away from MW. On the contrary, MW is moving away from the Centre of Supercluster. Some galaxies are moving toward MW, and the other are moving away. Then redshift depends on the position and movement of a particular galaxy in the Supercluster against MW.



More complicated situation with redshift is when galaxies belong to neighboring superclusters. No wonder that according to S. Gupta, over 8300 blue-shifted galaxies have been discovered beyond the Local Group in 2009. The Andromeda Galaxy is the nearest major galaxy to the Milky Way which is blue-shifted. How to explain all these results in standard cosmology?

According to WUM, the value of H should be measured based on MBR only. The calculated value of the Hubble's parameter in 2013: $H_0 = 68.73 \text{ km s}^{-1} \text{ Mpc}^{-1}$ is in excellent agreement with the most recent measured value in 2021: $H_0 = 68.7 \pm 1.3 \text{ km s}^{-1} \text{ Mpc}^{-1}$ using only MBR data.

Conclusion

WUM does not attempt to explain all available cosmological data, as that is an impossible feat for any one presentation. Nor does WUM pretend to have built an all-encompassing theory that can be accepted as is. The Model needs significant further elaboration and should be developed into a well-elaborated theory by the entire physical community.

WUM is a natural continuation of Classical Physics, and it can already serve as a basis for a New Cosmology proposed by P. Dirac. Considering JWST discoveries, successes of WUM, and 87 years of Dirac's proposals, it is high time to make a Paradigm Shift for Cosmology and Classical Physics.

Acknowledgements

I am always grateful to Academician A. Prokhorov and Prof. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father P. Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to N. Tesla who was a genius. I am much obliged to Prof. C. Corda for publishing my [manuscripts](#) in the Journal of High Energy Physics, Gravitation and Cosmology. I am grateful to N. Percival for his useful comments and suggestions, which have led to an overall improvement of the Presentation. Special thanks to my son Ilya Netchitailo who helped me clarify the Model and improve its understanding.

Presentation 2. Multicomponent Dark Matter [4][24][25][34]

Introduction

First of all, I would like to stress that **Hypersphere World** as a model of a finite universe was proposed by G. Riemann in 1854. World-Universe Model (WUM) follows this idea, albeit proposing that the World is stretching and filled with the Medium consisting of stable elementary particles.

Let me remind you the main results of the first Presentation “Medium of the World”:

- Microwave Background Radiation(MBR), Intergalactic Plasma, Far-Infrared Background Radiation (FIRB) speak in favor of existence of Medium, which is an absolute frame of reference;
- Time, Space, Gravitation are closely connected with Impedance, Gravitomagnetic parameter, and Energy density of the Medium. **There is no Medium - there is Nothing!**
- Critical energy density of the World can be found by the Hubble’s law. **There is no need in GR;**
- Medium consists of stable elementary particles: protons, electrons, photons, neutrinos, and Dark Matter Particles (DMPs). The relative energy density of DMPs is about 92.8% and Ordinary particles – about 4.8% in the Medium and 2.4% in Macroobjects (MOs);
- Maximum value of the velocity of electromagnetic waves equals to the value of the Electrodynamic constant c ;
- The most important Gravitational and Hubble’s parameters depend on the energy density of the Medium, which is Homogeneous and Isotropic;
- Thanks to the revealed by WUM Inter-Connectivity of Cosmological parameters, we show that the Gravitational parameter that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly.

Summary of the calculated by WUM in 2013 cosmological parameters and experimentally measured parameters are presented in the following Table.

Parameter	Calculated (2013)	Measured	Year
Gravitational	$6.67420 \times 10^{-11} m^3 kg^{-1} s^{-2}$	$6.674184 \times 10^{-11} m^3 kg^{-1} s^{-2}$	2018
Hubble’s	$68.733 km s^{-1} Mpc^{-1}$	$68.7 \pm 1.3 km s^{-1} Mpc^{-1}$	2021
Ionized Baryons	4.8 %	$4.9 \pm 1.3 %$	2016
Minimum Photon Energy	$1.87433 \times 10^{-14} eV$	$\lesssim 2.2 \times 10^{-14} eV$	2017
MBR Temperature	$2.725245 K$	$2.72548 \pm 0.00057 K$	2009
FIRB Temperature Peak	$28.955 K$	$29 K$	1998
Absolute Age of the World	$14.226 Byr$		

We emphasize that WUM allows for precise calculation of values that were only measured experimentally earlier and makes verifiable predictions.

Dark Stars

The basic feeling of many physicists is that Dark Matter (DM) does not exist because they believe that the DM construct was erroneously created due to a false analysis of the expected rotational velocity of stars in the outer range of spiral galaxies and also presumably due to a lack of knowledge about other evidence for DM. In the following Presentation, I will concentrate on a dismissal of this belief. I will provide a short review of the DM history for 240 years, in which great scientists were involved.

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**" and the first to have suggested that earthquakes travelled in (seismic) waves. The American Physical Society described Michell as being "*so far ahead of his scientific contemporaries that his ideas languished in obscurity, until they were re-invented more than a century later*". The Society stated that while "*he was one of the most brilliant and original scientists of his time, Michell remains virtually unknown today, in part because he did little to develop and promote his own path-breaking ideas*".

In the paper for the Philosophical Transactions of the Royal Society of London, read on 27 November 1783, 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. Please pay tribute to this genius physicist!

The first known binary system was Cygnus X-1, identified independently by several researchers in 1971 (188 years later). It remains among the most studied astronomical objects in its class. The compact object is now estimated to have a mass $\sim 21.2 M_{\odot}$. Cygnus X-1 is about 5 million years old. Though highly and erratically variable, Cygnus X-1 is typically the brightest persistent source of hard X-rays with energies up to 60 keV.

F. Bessel, Lord Kelvin, H. Poincaré, F. Zwicky, and many other great scientists discussed various aspects of DM. The hypothesis of Dark Stars was developed by well-known scientists: 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).

In 2020, R. Genzel and A. Ghez were awarded the Nobel Prize in Physics for "*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*". This discovery confirmed one of the most important predictions of WUM in 2013: "*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*".

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 $z \in [11, 14]$) are consistent with a Supermassive Dark Star interpretation, thus identifying, for the first time, Dark Star candidates*".

Dark Galaxies

A truly "dark galaxy" is an isolated cloud consisting only of DM. In some scenarios, it is possible that some optically dark objects may contain enough **atomic hydrogen** (HI) that a blind HI survey would detect them. A good example of "dark object" is the southwestern component of the binary system known as **HI1225+01**, discovered by R. Giovanelli and M. Haynes in 1989. While the northeastern HI component hosts a small, star

forming dwarf, the southwestern component has no detectable stellar counterpart. It is not an isolated object, being part of an apparent **binary system**.

Initially discovered in 2000, **VIRGOHI 21** was announced in 2005 as a good candidate to be a true Dark Galaxy. R. Minchin, *et al.* (2007) 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 ($\sim 200 \text{ km s}^{-1}$) 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. We have also used the Hubble Space Telescope to search for stars associated with the HI and find none*”.

The cloud is at the Virgo cluster’s distance of 52 Mly. It is roughly 50 kly across, about half the diameter of MW starry disk. The strength of the 21-cm emission indicates that the cloud harbors $2 \times 10^7 M_{\odot}$ 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 $9 \times 10^{10} M_{\odot}$* ”.

J-L. Xu, *et al.* (2023) obtained HI mass $8.3 \times 10^7 M_{\odot}$ of the galaxy **FAST J0139+4328**. Their findings provide observational evidence that this galaxy is an isolated dark dwarf galaxy. This is the first time that an isolated dark galaxy has been detected in the nearby universe.

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, *et al.* (2024) 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. It appears to be both undisturbed and underdeveloped. This could be our first discovery of a nearby galaxy made up of primordial gas*”.

In the case of **SDSSJ0826+5630** (8.8 Bly away), a radio signal (21-cm line) was magnified by another galaxy acting as a lensing body. N. Roy (2023) said that “*this effectively results in the magnification of the signal by a factor of 30, allowing the telescope to pick it up*”.



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).

The question is: where did this hydrogen gas get an Angular Momentum?

As the conclusion. Binary Galaxy systems including Dark Galaxies, were discovered:

- **HI1225+01** by R. Giovanelli and M. Haynes in 1989;
- **VIRGOHI 21** with **NGC 4254** by R. Minchin, *et al.* in 2000.

Prediction of John Mishell of the existence of Dark Stars is valid for Dark Galaxies also.

21-cm Emission

The 21-cm line refers to a **forbidden transition** in 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. The electromagnetic radiation producing this line has a frequency of 1420 MHz that is equivalent to a wavelength of 21.11 cm and a transition energy of $5.874 \mu\text{eV}$. This line has a very low transition probability, so it requires large amounts of hydrogen gas for it to be seen.

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 H₂ by cosmic rays*”. Then, **two questions arise**: where cosmic rays came from and how to explain broad line-width ($\sim 200 \text{ km s}^{-1}$) of 21-cm source?

R. Mondal and R. Barkana (2023) in article “Prospects for precision cosmology with the 21cm signal from the dark ages,” say “*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. Precision cosmology with 21 cm fluctuations requires a collecting area of 10 km² (corresponding to 400,000 stations)*”.

Galactic Rotation Curve

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 effects attributed to dark matter can be simply explained by the gravitomagnetic field produced by the mass currents.*

A developed WUM is based on **Gravitomagnetism**. The explanation of the galactic rotation curve made by Ludwig is in good agreement with the approach of WUM. We emphasize that **Gravitomagnetism considers not only interactions between masses but also between mass currents**, producing gravitomagnetic field. Equations for Gravitomagnetism were first published in 1893, before General Relativity (GR), by Oliver Heaviside as a separate theory expanding Newton’s law.

Superclusters

Galaxy clusters are particularly important for DM studies. Mass-to-light ratio of the Virgo Supercluster is ~ 300 times larger than that of Solar ratio. Similar ratios are obtained for other superclusters. These ratios are main arguments in favor of presence of significant amounts of DM in the World. Masses of superclusters can be estimated in two independent ways:

- From the scatter in radial velocities of the galaxies within clusters;
- Gravitational lensing can measure cluster masses without relying on observations of dynamics.

Multicomponent Dark Matter

Basic Ideas

It is the main goal of WUM to develop a Model based on two dimensionless parameters only: the dimensionless Rydberg constant α and the time-varying parameter Q , which is a measure of the Size and Age of the World. We often use well-known physical parameters, keeping in mind that all of them can be expressed through the Basic Units. 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 view, there is no way to prevent an occurrence of the Initial Singularity in Big Bang Model. A **Finite World** must have gotten started in a principally different way – a **Fluctuation** in the Eternal Universe with an extrapolated finite size that equals to the basic size unit of a :

$$a = 1.7705641 \times 10^{-14} m$$

The size of this Fluctuation can increase with a finite speed c (gravitodynamic constant). Then, there is no need to introduce Cosmological Inflation. However, a question about the mechanism of Continuous Creation of Matter in the World arises. According to WUM, the Eternal Universe is the Creator of the World's DMPs, which must have constant rest energies..

In 1952, Nobel Laureat in Physics Y. Nambu proposed an empirical mass spectrum of elementary particles with a mass unit close to one quarter of the mass of a pion ($m_0/2 \cong 35 \text{ MeV}/c^2$). He noticed that meson masses are even multiplies of a mass unit $m_0/2$, baryon (and also unstable lepton) masses are odd multiplies, and mass differences among similar particles are quantized by $m_0 \cong 70 \text{ MeV}/c^2$. In WUM we introduce a Basic Energy Unit E_0 that equals to:

$$E_0 = hc/a = 70.025252 \text{ MeV}$$

where h is the Planck constant. 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: $Ry = hcR_\infty = 0.5\alpha^3 E_0 = 13.605692 \text{ eV}$ (R_∞ is the Rydberg constant). Considering the main goal of WUM – two dimensionless parameters only – the rest energies of DMPs should be proportional to constant α only.

Indirect effects in cosmic rays and gamma-ray background from the **annihilation of Cold DM** in the form of heavy stable neutral leptons in Galaxies were considered in pioneer article by Nobel Laureates in Physics B. W. Lee and S. Weinberg in 1977. WUM follows this idea.

According to WUM, the World consists of DM (about 92.8% of the total Matter) and Ordinary matter (about 7.2%). It means that DM should play the main role in any Cosmological model. It is the case in WUM, and Ordinary matter is a byproduct of DMPs self-annihilation. In our opinion, it is high time to make a Paradigm Shift for **DM Cosmology and Classical Physics**.

Dark Matter Particles

Following the mechanism discussed by C. Boehm, *et al*, we proposed 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 the elementary charge); a heavy fermion – DMF2 (9.6 GeV) and a light spin-0 boson – ELOP (340 keV) that is a dipole of preons with electrical charge $e/3$; DMF3 (3.7 keV), DMF4 (0.2 eV), and boson XION (5.3 μeV).

In frames of WUM, Dark Matter Particles DMF1, DMF2, and DMF3 have rest energies, which corresponds to rest energies of Neutralinos, WIMPs, and Sterile Neutrinos discussed in literature. DMF4 constitute the biggest shell of DM Cores of Superclusters.

DIRAC, which is a magnetic dipole of Dirac's monopoles, is introduced to explain the Dirac's quantization condition. The quantum theory of magnetic charge started with a paper by P. Dirac in 1931. In this paper, he showed that if any magnetic monopoles exist in the universe, then all electric charge in the universe must be quantized. The electric charge is, in fact, quantized, which is consistent with (but does not prove) the existence of monopoles. Since Dirac's paper, several systematic monopole searches have been performed but it remains an open question whether monopoles exist. In our opinion, all electric charges are quantized due to existence of DIRACs – dipoles of Dirac's monopole, which are the smallest building blocks of the structure of constituent quarks and hadrons (mesons and baryons).

ELOP, which is an electric dipole of preons with the rest energy: $E_e/3 = 170.333 \text{ keV}$, is introduced to explain all subatomic particles with electrical charge $\propto e/3$. Preons are the smallest building blocks of the structure of quarks and leptons. According to I. A. D'Souza and C. S. Kalman "*In particle physics, preons are postulated "point-like" particles, conceived to be subcomponents of quarks and leptons*".

We did not consider binding energies of DIRACs and ELOPs, and thus the values of their rest energies are approximate. They have negligible electrostatic and electromagnetic charges because the separation between charges is very small. They do however possess electrostatic and electromagnetic dipole momentum.

XION is an analog of Axion discussed in literature. It has the value of the rest energy $5.3 \mu\text{eV}$. 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 $5 \mu\text{eV}$, axions could account for DM, and thus be both DM candidate and a solution to strong CP problem.

In our view, XIONS are responsible for the Le Sage's mechanism of gravitation. In WUM, Gravity is an emergent phenomenon.

The reason for this multicomponent DM system is to explain:

- The diversity of Very High Energy (VHE) 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.

WUM postulates that rest energies of DMFs and bosons are proportional to the basic energy unit E_0 multiplied by different exponents of α and can be expressed with the following formulae:

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

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

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

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

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

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

$$\text{XION (boson)} \quad E_{XION} = 1/2 \alpha^6E_0 = 5.2870895 \mu\text{eV}$$

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 these expected rest energies are found in spectra of the diffuse gamma-ray background and the emissions of various MOs in the World. We connect observed

gamma-ray spectra with the structure of MOs (nuclei and shells composition). Self-annihilation of those DMPs can give rise to any combination of gamma-ray lines. Thus, the diversity of VHE gamma-ray sources in the World has a clear explanation.

In this regard, it is worth recalling a story about neutrinos: “*The neutrino was postulated first by W. Pauli in 1930 to explain how beta decay could conserve energy, momentum, and angular momentum (spin). But we still don't know the values of neutrino masses*”. Although we still cannot measure neutrinos' masses directly, no one doubts their existence.

Neutrons serve as another example. The mass of a neutron cannot be directly determined by mass spectrometry since it has no electric charge. But since the masses of a proton and of a deuteron can be measured with a mass spectrometer, the mass of a neutron can be deduced by subtracting proton mass from deuteron mass, with the difference being the mass of the neutron plus the binding energy of deuterium.

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. We will discuss it below.

Distribution of World's Energy Density

Our Model holds that energy density of all types of self-annihilating DMPs is proportional to a basic proton energy density unit in the Medium ρ_p in all times that in the present Epoch equals to:

$$\rho_p = 2/3 (\pi^2 \alpha) \rho_{cr} = 0.048014655 \rho_{cr} \approx 4.8\%$$

where ρ_{cr} is the critical energy density of the World. In all, there are 6 different types of DMPs: DMF1, DMF2, DIRAC, ELOP, DMF3, and DMF4. Then the total energy density of DMPs ρ_{DM} is

$$\rho_{DM} = 6 \rho_p = 0.28808793 \rho_{cr} \approx 28.8\%$$

that is in good agreement with results of the literature. The total XION energy density ρ_{XION} is

$$\rho_{XION} = 1.35\pi^2 \rho_p = 0.63974563 \rho_{cr} \approx 64\%$$

The total baryonic energy density ρ_B is:

$$\rho_B = 1.5 \rho_p \approx 7.2\%$$

The sum of electron and Microwave Background Radiation energy densities ρ_{eMBR} equals to:

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

We take energy density of neutrinos ρ_ν to equal to MBR energy density ρ_{MBR} :

$$\rho_\nu = \rho_{MBR} = 2 (m_e/m_p) \rho_p$$

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 a 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 the conclusion:

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

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. We developed a theory of Fermion Compact Objects. 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.

According to WUM, Cores of Galaxies are DM Compact Objects made up of DMF1 and/or DMF2 with shell of DMF3 with the calculated maximum mass of $6 \times 10^{10} M_{\odot}$ (see **Table 1**). This value is in good agreement with the experimentally obtained value of the most massive black hole ever found, with a mass of $6.6 \times 10^{10} M_{\odot}$ at the center of TON 618. It is worth noting that there are no black holes in WUM.

Dark Matter Particles Signatures in Gamma-Ray Spectra

DMPs self-annihilation is proportional to the square of the DM density and is especially efficient in places of highest concentration of DMPs, such as compact stars built up from fermionic DMPs. By definition, X rays are emitted by electrons outside the nucleus, while gamma rays are emitted by the nucleus. In WUM, the **self-annihilation of DMPs gives rise to gamma-radiations**.

Physicists working in the field X-ray and gamma-ray astronomy attempt to determine masses of DMPs, which would fit experimental results with the developed models. WUM has principally different approach. The Model predicts existence of **Multicomponent DM system** consisting of DMPs with these values of rest

energies: 1.3 TeV, 9.6 GeV, 70 MeV, 340 keV, 3.7 keV, 0.2 eV, 5.3 μeV and look for signs of a self-annihilation of these particles in the observed gamma-ray spectra. We connect gamma-ray spectra with the structure (core and shells composition) of MOs. In frames of WUM, no MOs are made up of just a single type of DMPs, since other DMPs as well as baryonic matter are present in the shells. It follows that MOs irradiate gamma-quants in different spectral ranges with ratios of fluxes depending on structure of a given MO.

DMF1: 1.3 TeV

R. Chaves, *et al.* (2009) have found that a significant fraction of galactic VHE gamma-ray sources do not appear to have obvious counterparts at other wavelengths. In frames of WUM, the correlation between keV and TeV emissions can be easily explained by the self-annihilation of DMF3 (3.7 keV) in the shell around the core of Active Galactic Nucleus made up of DMF1 (1.3 TeV). Lack of a counterpart in gamma-ray spectra means that DMF3 shell is too small to be observed.

A detailed analysis on interpretation of latest data of different collaborations (PAMELA, Fermi-LAT, AMS-02, H.E.S.S) in terms of DM annihilation and decay in various propagation models showed that for the Fermi-LAT and H.E.S.S. data DMP mass is $m_\chi \approx 1.3 \text{ TeV}$ [Aleksic, J., *et al.* (2013); Moralejo, A. (2013); Abramowski, A., *et al.* (2013); Jin, H. B., *et al.* (2013)].

The obtained data by other collaborations require DMP mass m_χ to be around 1 to 1.5 TeV, which is in good agreement with the predicted mass of DMF1 (1.3 TeV) [Abdo, A. A., *et al.* (2009); Adriani, O., *et al.* (2011); He, X. G. (2009); Cholis, I., *et al.* (2010); Morselli, A. (2011); Abazajian, K. N., *et al.* (2011); Kawanaka, N., *et al.* (2010); Aharonian, F. A., *et al.* (2008); Ibarra, A., *et al.* (2010)].

The presence of spectral break at 1.3 TeV in VHE spectra was measured for different blazars [Orr, M., Krennrich, F. (2011); Orr, M., *et al.* (2011); Madhavan, A. (2013)]. Some nearby sources (Vela, Cygnus Loop, Monogem Supernova Remnant) have unique signatures in the TeV region: broken power-law at $\sim 1.3 \text{ TeV}$ [Torii, S. (2014)]. The DM interpretations of the e^\pm excesses observed by PAMELA, Fermi and ATIC suggest the DMP mass of 1.3 TeV [Papucci, M., Strumia, A. (2009)].

DMF2: 9.6 GeV

D. Hooper summarized and discussed the body of evidence which has accumulated in favor of DM in the form of approximately 10 GeV particles, including *the spectrum and angular distribution of gamma rays from the Galactic Center; the synchrotron emission from the Milky Way's radio filaments, the diffuse synchrotron emission from the Inner Galaxy and low-energy signals from the direct detection experiments DAMA/LIBRA, CoGeNT and CRESST-II.*

It is worth noting that a similar excess of gamma-rays was observed in the central region of Andromeda galaxy. A. McDaniel, *et al.* (2018) found that the best fitting models are with the DMP mass 11 GeV.

Based on EGRET observations, P. Sreekumar, *et al.* (1997) attribute VHE emissions to blazars: *Most of the measured spectra of individual blazars only extend to several GeV and none extend above 10 GeV.* WUM proposes that cores of blazars are composed of self-annihilating DMF2 (9.6 GeV), explaining why no observed radiation extends above 10 GeV.

DIRAC: 70 MeV

S. Hunter, *et al.* (1997) discuss a peak at 67.5 MeV: *Below 100 MeV, gamma rays produced via electron bremsstrahlung are the dominant component of the observed spectrum, whereas, above about 100 MeV, the gamma-rays from π^0 decay are the dominant component of the spectrum.*

70 MeV peak in EGRET data was discussed by Golubkov and Khlopov (2000) who explained it by the decay of π^0 -mesons, produced in nuclear reactions. B. Wolfe, *et al.* (2008) said that gamma rays at 70 MeV

are detectable by GLAST and EGRET. R. Yamazaki, *et al.* (2006) and Nakamori, T. (2012) attribute this peak in the emission spectrum from an old supernova remnant to π^0 -decay.

Note that whenever the 70 MeV peak appears in gamma-ray spectra, it is always attributed to pion decay. We claim that π^0 decay produces the 67.5 MeV peak, while DIRACs self-annihilation is responsible for 70 MeV peak. To find out the source of the observed broad peak about 70 MeV, we suggest utilization of exponentially cutoff power-law for analysis of experimental data for gamma-ray energies < 70 MeV. A better fit of experimental data will be evidence of DIRACs self-annihilation.

ELOP: 340 keV

Existence of DMPs of similar masses ($m_\chi < 0.42$ MeV) has been discussed by Y. Rasera, *et al.* (2006). The experimental 100-400 keV “bump” discussed by Zdziarski, A. A. (1996) is in good agreement with a theoretical analysis of Y. Rasera, *et al.* and with self-annihilating DMPs ELOPs.

D. Gruber, *et al.* (1999) describe a wide gamma-ray extragalactic background spectrum between 1 keV and 10 GeV and conclude that “*the fit required the sum of three power laws*”.

According to WUM, the fit of the total diffuse spectrum in the range between 3 keV and 10 GeV should be performed based on three exponentially cutoff power-laws with injection spectral $J(E) \propto E^{-\gamma} \exp\{-E/E_{cut}\}$ with the spectral index γ and E_{cut} being the cutoff energy of the source spectra. For values of E_{cut} , we should use:

- 9.6 GeV (self-annihilating DMF2) in the 9.6 GeV – 70 MeV range;
- 70 MeV (self-annihilating DIRACs) in the 70 MeV – 340 keV range;
- 340 keV (self-annihilating ELOPs) in the 340 keV – 3.7 keV range.

The fit in the range between 9.6 GeV and 1.3 TeV should be done with $E_{cut} = 1.3$ TeV (DMF1).

DMF3: 3.7 keV

The very first signature of the emission around 3.7 keV was found in 1967 by P. Gorenstein, *et al.* They found that *the highest number of net counts is recorded in the bin centered at 3.75 keV*.

An important result was obtained by S. Safi-Harb and H. Ogelman in 1997. They reported *the observations of the X-ray lobes of the large Galactic source W50. A broken power-law model gives the best fit. The power-law indices are 1.9 and 3.6, with the break occurring at 3.7 keV*.

T. Itoh (2007) analyzed the broad-band (3.0 – 50 keV) spectra of NGC 4388 and found line-like residual around 3.7 keV at the high confidence level.

In 2012, A. Moretti, *et al.* measured the diffuse gamma-ray emission at the deepest level and with the best accuracy available. Emission line around 3.7 keV is clearly visible in the obtained spectrum.

DMF4: 0.2 eV

Unidentified Infrared emission bands are infrared discrete emissions from circumstellar regions, interstellar media, star-forming regions, and extragalactic objects for which the identity of the emitting materials is unknown. They are, in fact, the “Fingerprints” of all galaxies.

The main infrared features occur around peaks at 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm with the photon’s rest energy at the peaks 0.376, 0.200, 0.161, 0.144, 0.111, and 0.098 eV, respectively. This phenomenon has been studied for about 45 years. The prevailing hypothesis is that the materials responsible for this phenomenon are **polycyclic aromatic hydrocarbon molecules**, which are thought to be one of the main forms in which carbon exists in space. And yet, not a single member of this group of compounds had been identified in space definitively until now.

In WUM, by analogy with electron-positron annihilation, we suppose that particles DMF4 and bi-DMF4

self-annihilate with the emission of two or three gamma-quants. Indeed, the self-annihilation of them follows an energy conservation requirement:

- Two bi-DMF4 particles with the rest energy about 0.38 eV can produce two gamma-quants with the energy 0.376 eV (3.3 μm);
- Two DMF4 particles (0.199 eV) can produce two gamma-quants with energy 0.200 eV (6.2 μm);
- Two DMF4 particles can produce three gamma-quants with energies 0.161 eV (7.7 μm), 0.144 eV (8.6 μm), and 0.111 eV (11.2 μm), or 0.098 eV (12.7 μm);

XION: 5.3 μeV

Concentration of XIONs (the rest energy 5.287 μeV) inside of DM clouds is considerably larger (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 $\geq 5.874 \mu\text{eV}$. A self-annihilation of an **ensemble of XIONs** with energies around 5.874 μeV produces 21 cm radiation with broad line-width ($\sim 200 \text{ km s}^{-1}$). In frames of WUM, there is no need in hydrogen atoms, for which there is no explanation for a mechanism of their production. **Dark Galaxies are made of DMPs only!**

Conclusion

Dark Matter is abundant:

- 2.4 % of Ordinary Matter is in Superclusters, Galaxies, Stars, Planets, etc.
- 4.8 % of Ordinary Matter is in the Medium of the World;
- The remaining 92.8 % is DM.

Dark Matter is omnipresent:

- 2/3 of the total DM is in the Medium of the World;
- 1/3 of the total DM is in MOs of the World;
- DM Reactors in Cores of all gravitationally-rounded MOs.

WUM predicts existence of DMPs with 1.3 TeV, 9.6 GeV, 70 MeV, 340 keV, 3.7 keV, 0.2 eV, and 5.3 μeV rest energies. We should concentrate our efforts on the observations of cosmic gamma-rays with spectral lines corresponding to the predicted values of DMPs rest energies.

In our view, great experimental results and observations achieved by Astronomy should be analyzed through the prism of WUM. Astronomers should plan new targeted experiments based on the results of these analyses. Considering the JWST discoveries, successes of WUM, and 87 years of Dirac's proposals, it is high time to make a Paradigm Shift for DM Cosmology and Classical Physics.

Acknowledgements

I am always grateful to Academician A. Prokhorov and Prof. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father P. Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to N. Tesla who was a genius. I am much obliged to Prof. C. Corda for publishing my [manuscripts](#) in the Journal of High Energy Physics, Gravitation and Cosmology. I am very grateful to N. Percival for his useful comments and suggestions, which have led to an overall improvement of the Presentation. Special thanks to my son Ilya Netchitailo who helped me clarify the Model and improve its understanding.

Presentation 3. Angular Momentum.

Formation of Macrostructures [10][29][33][35]

Introduction

First of all, I would like to stress that a **Hypersphere** is an example of a **3-Manifold** which locally behaves like **Euclidean 3D space**: just as a sphere looks like a plane to small enough observers. In Classical Physics and our everyday life we use alleged Space (3D Euclidean) and Solar Time t . My Model based on Cosmological time τ that is defined by **Impedance** (Wave Resistance) of the Medium that equals to Hubble's parameter H . Cosmological time is inversely proportional to H : $\tau = H^{-1}$. It marches on at a constant pace from the Beginning of the World up to the present Epoch along with time-varying Cosmological parameters and defines the Absolute Age of the World: $A_\tau = \tau$. Time is not a physical dimension and is absolutely different entity than Space. Time is a Factor of the World.

Let me remind you the main results of the second Presentation "Multicomponent Dark Matter":

- Critical energy density of the World can be found by the Hubble's law only. There is no need in General Relativity;
- Medium consists of stable elementary particles: protons, electrons, photons, neutrinos, and Dark Matter Particles (DMPs). The relative energy density of Ordinary particles – about 4.8% in the Medium (which was experimentally measured by Fast Radio Bursts), 2.4% in Macroobjects (MOs), and the rest 92.8% is the relative energy density of DMPs (what else could be?);
- Multicomponent DM system explains: a diversity of Very High Energy gamma-ray sources in the World and the diversity of DM Cores of Macroobjects of the World: Superclusters, Galaxies, and Extrasolar Systems (ESS), which are Fermion Compact Objects and DM Reactors in our Model;
- Binary Galaxy systems including Dark Galaxies, were discovered – by R. Giovanelli and M. Haynes in 1989 (**HI1225+01**) and by R. Minchin, *et al.* in 2000 (**VIRGOHI 21** with **NGC 4254**). Prediction of John Mishell of the existence of Dark Stars is valid for Dark Galaxies also;
- There is no need in DM to explain Galactic Rotation Curves. It might be the explanation by G. O. Ludwig (the gravitomagnetic field produced by the mass currents) and/or by D. De Hilster who calculated the rotational curves as a disk instead of a sphere;
- Unidentified Infrared emission bands around peaks at 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm , which are the fingerprints of all galaxies, explained by the self-annihilation of DMPs **DMF4** (0.2 eV) instead of the **polycyclic aromatic hydrocarbon molecules**, not a single member of which had been identified in space definitively for forty five years observations until now;
- 21-cm Emission with the broad line-width ($\sim 200 \text{ km s}^{-1}$) explained by the self-annihilation of an **ensemble** of ultra-relativistic DMPs **XIONs** ($5.3 \mu\text{eV}$) instead of the **forbidden transition** in neutral hydrogen atoms, for which there is no explanation for a mechanism of their production.

Dark Galaxies are made of DMPs only!

Angular Momentum Problem

Angular Momentum problem is one of the most critical problems in Standard cosmology that must be solved. Prof. Leon Mestel in his paper on star formation in *Quarterly Journal of the Royal Astronomical Society* (1965) realized the full extent of the angular momentum "problem". It was found that the angular momentum

of a protoplanetary disk is misappropriated when compared to models during stellar birth. Sun and other stars are predicted by models to be rotating considerably faster than they actually are.

S. A. Colgate and A. G. Petschek (Los Alamos Science, 1986) in article “Angular Momentum – the Cosmic Pollutant” wrote: *There seems to be **too much angular momentum in the universe** to allow the formation of stars or the accretion of matter onto variable x-ray sources. **This fundamental problem begs for solution.***

*When we have too much of something and cannot find a way of getting rid of it, we often think of it as a **pollutant**. In the game of concentration and collapse of matter in the universe from clouds of gas to clusters of galaxies, galaxies, stars, planets, and black holes, **angular momentum is the “pollutant”** that prevents the game from being played to the absolute limit, namely, collapse into one awesome black hole for each cluster-sized cloud condensed from the early universe.*

In my opinion, Angular Momentum problem is the killer of all existent cosmological models including Big Bang model. Old-timers of Cosmology should solve this problem.

To the best of our knowledge, the modified in 2018 Hypersphere World-Universe Model (WUM) is the only one cosmological model in existence that is consistent with the **Law of Conservation of Angular Momentum**. I absolutely agree with Richard Feynman who said: *It doesn't make any difference how beautiful your guess is, it doesn't make any difference how smart you are, who made the guess, or what his name is. If it disagrees with experiment, it's wrong. That's all there is to it.*

Short History of Solar System Formation

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

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

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

Lunar origin fission hypothesis was proposed by G. Darwin in 1879 to explain the origin of the Moon by rapidly spinning Earth, on which equatorial gravitative attraction was nearly overcome by centrifugal force. D. 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”.*

Solar Fission theory was proposed by L. Jacot in 1951 who stated that:

- The planets were expelled from the Sun one by one from the equatorial bulge caused by rotation;
- One of these planets shattered to form the asteroid belt;
- The moons and rings of planets were formed from the similar expulsion of material from their parent planets.

T. Van Flandern extended this theory in 1993. Flandern proposed that planets were expelled from the Sun in pairs at different times. Six original planets exploded to form the rest of the modern planets. It solves several problems the standard model does not:

- If planets fission from the Sun due to overspin while the proto-Sun is still accreting, this more easily explains how 98% of the solar system's angular momentum ended up in the planets;
- It solves the mystery of the dominance of prograde rotation for these original planets since they would have shared in the Sun's prograde rotation at the outset;
- It also explains coplanar and circular orbits;
- It is the only model that explains the twinning of planets (and moons) and difference of planet pairs because after each planet pair is formed in this way, it will be some time before the Sun and extended cloud reach another overspin condition.

The outstanding issues of the Solar Fission are:

- It is usually objected that tidal friction between a proto-planet and a gaseous parent, such as the proto-Sun, ought to be negligible because the gaseous parent can reshape itself so that any tidal bulge has no lag or lead, and therefore transfers no angular momentum to the proto-planet;
- There would exist no energy source to allow for planetary explosions.

Neither L. Jacot nor T. Van Flandern proposed an origin for the Sun itself. It seems that they followed the standard Nebular hypothesis of formation of the Sun.

In Hypersphere World-Universe Model, we concentrate on furthering a Solar Fission theory.

Explosive Volcanic Rotational Fission Model

To be consistent with the Law of Conservation of Angular Momentum, any theory of evolution must answer the following questions:

- How did Galaxies and ESS get their substantial orbital and rotational angular momenta;
- How did Milky Way (MW) galaxy give birth to different ESS in different times;
- The age of MW is about the Age of the World. What is the origin of MW huge orbital and rotational angular momenta? We must discuss the Beginning of MW;
- The oldest star in MW (Methuselah) is nearly as old as the universe itself. How did it happen?
- The beginning of SS was 4.57 Byr ago. What is the origin of SS rotational and orbital angular momenta? We must discuss the Beginning of SS also;
- P. Wang, *et al.* (2021) made a great discovery: "*Most cosmological structures in the universe spin. Although structures in the universe form on a wide variety of scales from small dwarf galaxies to large super clusters, the generation of angular momentum across these scales is poorly understood*". We must discuss the Beginning of the World.

Rotational Fission

In our opinion, there is only one mechanism that can provide angular momenta to Macroobjects – **Rotational Fission** of overspinning (surface speed at equator exceeding escape velocity) Prime Objects. From

the point of view of Fission model, the Prime object is transferring some of its rotational angular momentum to orbital and rotational momenta of satellites. It follows that **rotational momenta of prime objects should exceed orbital momenta of their satellites.**

In frames of WUM, Prime Objects are Dark Matter (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**”. In 2018, we modified WUM the following way that gives a principally new picture of the World:

- WUM introduces Dark Epoch (spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr) when only DM Macroobjects (MOs) existed in the **Medium** of the World (which we discussed in Presentation 1), and Luminous Epoch (ever since for 13.77 Byr for Laniakea Supercluster) when Luminous MOs emerged due to the Rotational Fission of Superclusters’ DM Cores and self-annihilation of Dark Matter Particles (DMPs);
- Main players of the World are Superclusters’ DM Cores, which accumulated tremendous rotational angular momenta during Dark Epoch by absorbing DMPs from the Medium inside of rotating DM Cores. Their self-annihilation at each point of Cores generates gamma quants and clouds of different particles, atoms, ions of ordinary matter as the result of interaction of very-high energy gamma quants with the surrounding particles of ordinary matter;
- These particles have large Linear Momenta in all 360° . Particles with momentum directions along of Cores’ axes of rotation leave them into Medium. This is a Superclusters Wind analogous to the Stellar and Galaxy Winds;
- Particles with momentum directions perpendicular to Cores’ axes of rotation have different momenta depending on their directions: particles with momenta \mathbf{p}_+ along with local rotating speed \mathbf{V}_{loc} have a sum speed larger than particles with momenta \mathbf{p}_- against \mathbf{V}_{loc} . It means that Core has additional angular momentum according to the equation $\mathbf{L}_{add} = \mathbf{R}_{loc} \times (\mathbf{p}_+ - \mathbf{p}_-)$ (where parameters are vectors and \mathbf{R}_{loc} is a radius-vector of the discussed local point from axes of rotation);
- The accumulated by DM Cores of Superclusters rotational momenta transferred to DM Cores of Galaxies as the result of their Rotational Fission;
- The experimental observations of galaxies in the World show that most of them are disk galaxies. These results speak in favor of the developed Rotational Fission mechanism;
- Milky Way’s DM Core was born 13.77 Byr ago as the result of Rotational Fission of Virgo Supercluster’s DM Core;
- DM Cores of ESS, planets and moons were born as the result of the repeating Rotational Fissions of Milky Way’s DM Core in different times (4.57 Byr ago for SS);
- Macrostructures of the World form from the top (superclusters) down to galaxies and ESS.

Multicomponent Dark 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 an elementary charge and α is the 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). The reason for this multicomponent DM system was to explain the diversity of DM Cores of MOs of the World (superclusters, galaxies, and ESS). We discussed this Multicomponent DM system in Presentation 2.

Macroobject Shell Model

In WUM, Macrostructures of the World (Superclusters, Galaxies, and ESS) 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 MOs Cores made up of different Fermions in present Epoch.

Fermion	Fermion Rest Energy, 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 stars in ESS;
- 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.

Dark Matter Cores of Macroobjects

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 7.2% of the total Matter) is a byproduct of DMPs self-annihilation. It is re-emitted by Cores of MOs continuously;
- According to WUM, a rotational angular momentum of overspinning (surface speed at equator exceeding escape velocity) object before rotational fission is:

$$L_{rot} \propto G^{0.5} M_{MO}^{1.5} R_{MO}^{0.5}$$

where G is the Gravitational parameter, M_{MO} is a mass of overspinning Macroobject, R_{MO} is its radius. These parameters are time-varying: $G \propto \tau^{-1}$, $M_{MO} \propto \tau^{3/2}$ and $R_{MO} \propto \tau^{1/2}$. It follows that the rotational angular momentum of Cores L_{rot} is proportional to $L_{rot} \propto \tau^2$;

- Nuclei and shells are growing in time: size $\propto \tau^{1/2}$; mass $\propto \tau^{3/2}$; and rotational angular momentum $\propto \tau^2$, until they reach the critical point of their stability, at which they detonate. Satellite cores and their orbital L_{orb} and rotational L_{rot} angular momenta released during detonation are produced by Overspinning DM Cores. The detonation process does not destroy them; it is rather gravitational hyper-flares;
- Size, mass, composition, L_{orb} and L_{rot} of satellite DM cores depend on local density fluctuations at the edge of Overspinning DM Cores. Consequently, a diversity of satellite DM cores has a clear explanation. Satellite DM cores are given off by Volcanos on prime DM cores erupting repeatedly;

- WUM refers to Overspinning DM Core detonation process as Gravitational Burst (GB), analogous to Gamma Ray Burst.
In frames of WUM, **repeating Gravitational Bursts** can be explained the following way:
- As the result of GB, the Overspinning DM Cores lose a small fraction of their mass and a large part of their rotational angular momentum;
- After GB, 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, stars, planets, and moons) are rotating around their own axes and DM Cores of Prime Objects;
- Afterglow of GB 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 Cores absorb new DMPs, increase their mass $\propto \tau^{3/2}$ and get rid of extra L_{rot} by star wind particles;
- Solar wind is the afterglow of the Solar Core detonation 4.57 Byr ago. It is the result of ongoing and current dynamics withing the Sun;
- In case of Galaxies, a galactic wind is the afterglow of the repeating galactic DM Core detonations. In MW, it continuously creates two **DM Fermi Bubbles**.

Formation of Macrostructures

Dark Epoch

Dark Epoch started at the Beginning of the World 14.22 Byr ago and lasted for 0.45 Byr for Laniakea Supercluster. WUM is a classical model, therefore classical notions can be introduced only when the very first ensemble of particles was created at the cosmological time $\tau_M \cong 10^{-18}s$. At time $\tau \gg 10^{-18}s$ density fluctuations could happen in the Medium of the World filled with DMPs. The heaviest particles DMF1 could collect into a cloud with distances between particles smaller than the range of a proposed weak interaction. As the result of the weak interaction, which is about 30 orders of magnitude greater than gravitational interaction, clumps of DMF1 will arise. They have random initial rotational angular momenta according to the equation $L_{clump}^{rot} = \sum_i \mathbf{r}_i \times \mathbf{p}_i$ (where \mathbf{r}_i is the position vector of particle i with respect to the center of mass and \mathbf{p}_i is the linear momentum of particle i with respect to the center of mass).

Larger clumps will attract smaller clumps and DMPs and initiate a process of expanding the DM clump followed by growth of surrounding shells made up of other DMPs, up to the maximum mass of the shell made up of DMF4 at the end of Dark Epoch.

The process described above is the formation of the DM Core of Superclusters. DMPs supply not only additional mass ($\propto \tau^{3/2}$) to Cores, but also additional angular momentum ($\propto \tau^2$) fueling the overspinning of DM Cores. We estimate the number of main Supercluster Cores at the end of Dark Epoch to be 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.

Luminous Epoch

Detailed analysis of the rotational angular momenta of overspinning DM Cores of MOs before rotational fission showed that:

- As the result of rotational fission of Virgo Superclusters' Core 13.77 Byr ago, approximately $\sim 10^6$ galaxies like MW could be generated at the same time. Considering that Virgo Supercluster has grown inside out

(in the present Epoch, most old galaxies can be found in the middle, more recently formed ones on the outskirts), the number of generated galaxies could be much larger;

- As the result of rotational fission of MW Core 13.77 Byr ago, about $\sim 10^4$ ESS like SS could be created at the same time. Considering that MW has grown inside out (old stars are in the middle, recently formed ones on the outskirts), the number of generated ESS could be much larger.

Extrasolar system DM Cores can give birth to planetary DM cores, which in turn can generate DM cores of moons by the same Rotational Fission mechanism. **Luminous Epoch** is the result of Explosive Volcanic Rotational Fission of DM Cores of Superclusters and self-annihilation of DMPs.

In our view, random Explosive Volcanic Rotational Fission of DM Core of Prime Object 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 the angular momentum of the Prime Object. There are no preferences of directions of satellites rotations at any level (supercluster, galaxy, solar system) vs random rotation direction. DM Cores of Prime Objects detonate at critical points of their stability, which **principally depend on the accumulated Rotational Angular Momenta**.

As a summary:

- The rotational fission of Macroobjects DM Cores is the most probable process that can generate satellite DM cores with large rotational and orbital momenta in a very short time;
- Macrostructures of the World form from the top (superclusters) down to galaxies, ESS, planets, and moons.

Macrostructures

Laniakea Supercluster (LSC) is a galaxy supercluster that is home to MW and approximately 10^5 other nearby galaxies (see **Figure 1**). It is known as one of the largest superclusters with estimated by L. Bliss, *et al.* binding mass $10^{17} M_{\odot}$. The neighboring superclusters to LSC are the Shapley Supercluster, Hercules Supercluster, Coma Supercluster, and Perseus-Pisces Supercluster (see **Figure 2**). Distance from the Earth to the Centre of LSC is about 250 Mly.

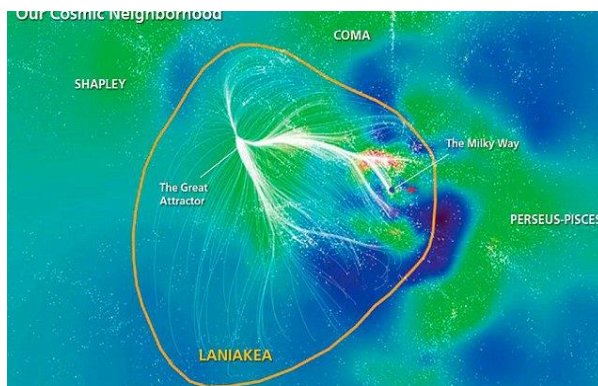


Figure 1. Laniakea Supercluster. Adapted from the article by Tully, R. B., *et al.* (2014).

The mass-to-light ratio of Virgo Supercluster is about 300 times larger than that of the Solar ratio. Similar ratios are obtained for other superclusters. In 1933, F. Zwicky investigated the velocity dispersion of Coma cluster and found a surprisingly high mass-to-light ratio (~ 500). He concluded: *If this would be confirmed, we would get the surprising result that dark matter is present in much greater amount than luminous matter.* These ratios are one of the main arguments in favor of the presence of large amounts of DM in the World and validate the developed Model of Superclusters' Macrostructure.

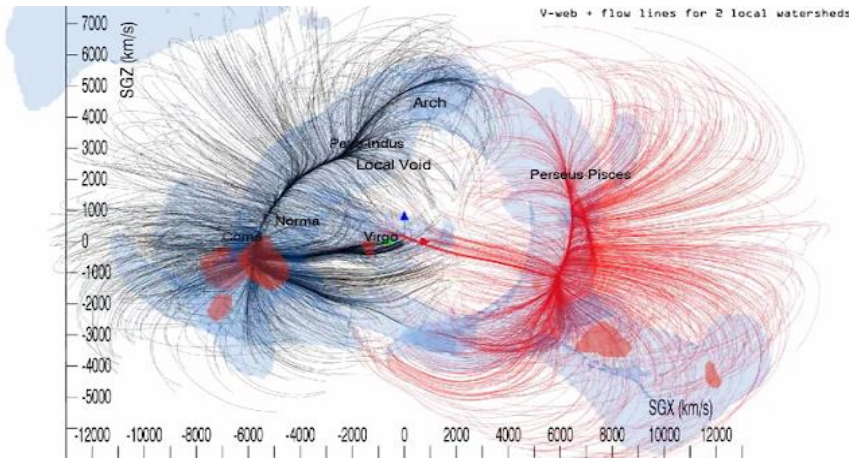


Figure 2. A representation of structure and flows due to mass within $6,000 \text{ km s}^{-1}$ ($\sim 80 \text{ Mpc}$). Adapted from the article by Tully, R. B., *et al.* (2014).

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. It means that the World is, in fact, a Patchwork Quilt of different Luminous Superclusters ($\geq 10^3$).

According to R. B. Tully, *et al.*, (2014) *"Galaxies congregate in clusters and along filaments and are missing from large regions referred to as voids. These structures are seen in maps derived from spectroscopic surveys that reveal networks of structure that are interconnected with no clear boundaries. Extended regions with a high concentration of galaxies are called 'superclusters', although this term is not precise"*.

P. Wang, *et al.* (2021) made a great discovery: *"Most cosmological structures in the universe spin. Although structures in the universe form on a wide variety of scales from small dwarf galaxies to large super clusters, the generation of angular momentum across these scales is poorly understood. We have investigated the possibility that filaments of galaxies - cylindrical tendrils of matter hundreds of millions of light-years across, are themselves spinning. By stacking thousands of filaments together and examining the velocity of galaxies perpendicular to the filament's axis (via their red and blue shift), we have found that these objects too display motion consistent with rotation making them the largest objects known to have angular momentum. These results signify that angular momentum can be generated on unprecedented scales"*.

In 2021, A. Lopez reported about the discovery of *"a giant, almost symmetrical arc of galaxies - the Giant Arc - spanning 3.3 billion light years at a distance of more than 9.2 billion light years away that is difficult to explain in current models of the Universe. The Giant Arc, which is twice the size of the Sloan Great Wall of galaxies and clusters that is seen in the nearby Universe. This new discovery of the Giant Arc adds to an accumulating set of (cautious) challenges to the Cosmological Principle."*

B. Carr, *et al.* (2020) *"consider the observational constraints on stupendously large black holes (SLABs) in the mass range $M > 10^{11} M_{\odot}$. These have attracted little attention hitherto, and we are aware of no published constraints on a SLAB population in the range $(10^{12} - 10^{18}) M_{\odot}$. However, there is already evidence for black holes of up to nearly $10^{11} M_{\odot}$ in galactic nuclei, so it is conceivable that SLABs exist, and they may even have been seeded by primordial black holes"*.

WUM. These latest observations of the World can be explained in frames of WUM only:

- *"Galaxies do not congregate in clusters and along filaments"*. On the contrary, Cosmic Web that is *"networks of structure that are interconnected with no clear boundaries"* is the result of the Rotational Fission of DM Cores of neighbor Superclusters;

- “*Generation of angular momentum across these scales*” provide DM Cores of Superclusters through the Rotational Fission mechanism;
- “*Spinning cylindrical tendrils of matter hundreds of millions of light-years across*” are the result of spiral jets of galaxies generated by DM Cores of Superclusters with internal rotation;
- The Giant Arc is the result of the intersection of the Galaxies’ jets generated by the neighbor DM Cores of Superclusters;
- The calculated maximum mass of supercluster DM Core of $2.1 \times 10^{19} M_{\odot}$ is in good agreement with the values discussed by L. Bliss ($10^{17} M_{\odot}$) and by B. Carr, *et al.* ($10^{12} - 10^{18}$) M_{\odot} . In the future, these stupendously large compact objects can give rise to new Luminous Superclusters as the result of their DM Cores’ rotational fission;
- 13.77 Byr ago, when the Laniakea Supercluster emerged, the estimated number of main DM Supercluster Cores in the World was around $\geq 10^3$. It is unlikely that all of them gave birth to Luminous Superclusters at the same cosmological time being far away from each other. The 3D Finite Boundless World presents a Patchwork Quilt of different Luminous Superclusters, which emerged in various places of the World at different Cosmological times;
- The distribution of MOs in the World is spatially Inhomogeneous and Anisotropic and temporally Non-simultaneous. Cosmological principal is valid for the Homogeneous and Isotropic Medium of the World consisting of elementary particles with 2/3 of the total Matter. The distribution of MOs with 1/3 of the total Matter is Inhomogeneous and Anisotropic, and therefore, the Cosmological Principal is not viable;
- The main conjecture of BBM: “*Projecting galaxy trajectories backwards in time means that they converge to the Initial Singularity at $t=0$ that is an infinite energy density state*” is wrong because all Galaxies are gravitationally bound with their Superclusters (see **Figure 1, Figure 2**). **Big Bang never happened.**

JWST Discoveries

The problem of ancient galaxies formation is a long-standing problem. The age of the Universe is 13.77 ± 0.06 Byr , based on the cosmic microwave background data. Astronomers believe that our own MW galaxy is approximately 13.6 Byr old. MW is one of the two largest spiral galaxies in the Local Group (the other being the Andromeda Galaxy). Massive mature disk galaxies like MW cannot form so soon.

Distances to remote objects, other than those in nearby galaxies, are nearly always inferred by measuring the cosmological redshift of their light. An important distinction is whether the distance is determined via spectroscopy or using a photometric redshift technique. The spectroscopic redshift is conventionally regarded as being necessary for an object's distance to be considered definitely known, whereas photometrically determined redshifts identify "candidate" distant sources. For comparisons with the light travel distance of the astronomical objects listed below, the age of the universe since the Big Bang (BB) is currently estimated as 13.787 ± 0.020 Byr.

Below we discuss Macroobjects with $z > 10$ (see **Table 2** and **Table 3**, adapted from Wikipedia).

The presented experimental results (2022) show that:

- HD1 is one of the earliest and most distant known galaxies yet identified in the observable universe. HD1's unusually high brightness has been an open question for its discoverers; it has a significantly more luminous ultraviolet emission than similar galaxies at its redshift range [Pacucci, F., *et al.*].
- F200DB-045 is a candidate high-redshift galaxy, with an estimated redshift of $z = 20.4$. If confirmed, it would be one of the earliest and most distant known galaxies observed. F200DB-045 would have a light-travel distance (lookback time) of > 13.7 Byr .

Table 2. Most distant galaxies with spectroscopic redshift determinations

Name	Redshift	Light travel distance, Bly
HD1	$z = 13.27$	13.579; 13.599; 13.477; 13.476
JADES-GS-z13-0	$z = 13.20^{+0.24}_{-0.07}$	13.576; 13.596; 13.474; 13.473
JADES-GS-z12-0	$z = 12.63^{+0.24}_{-0.08}$	13.556; 13.576; 13.454; 13.453
GLASS-z12	$z = 12.117^{+0.01}_{-0.01}$	13.536; 13.556; 13.434; 13.433
JADES-GS-z11-0	$z = 11.58^{+0.05}_{-0.05}$	13.512; 13.532; 13.410; 13.409
GN-z11	$z = 10.957^{+0.001}_{-0.001}$	13.481; 13.501; 13.380; 13.379
UDFj-39546284	$z = 10.38^{+0.07}_{-0.06}$	13.449; 13.469; 13.348; 13.347

Table 3. Notable candidates for most distant galaxies

Name	Redshift	Light travel distance, Bly
F200DB-045	$z = 20.4^{+0.3}_{-0.3}$	13.725; 13.745; 13.623; 13.621
CEERS-93316	$z = 16.39^{+0.32}_{-0.22}$	13.661; 13.681; 13.559; 13.558
F200DB-175	$z = 16.2^{+0.3}_{-0.0}$	13.657; 13.677; 13.555; 13.554
S5-z17-1	$z = 16.0089^{+0.0004}_{-0.0004}$	13.653; 13.673; 13.551; 13.550
F150DB-041	$z = 16.0^{+0.2}_{-0.2}$	13.653; 13.673; 13.551; 13.549
SMACS-z16a	$z = 15.92^{+0.17}_{-0.12}$	13.651; 13.671; 13.549; 13.548
F200DB-015	$z = 15.8^{+3.4}_{-0.1}$	13.648; 13.668; 13.546; 13.545

Detailed analysis of observations of the first batch of $z \approx 11$ –20 Candidate Objects revealed by JWST is done by H. Yan, *et al.* (2022). The summary of the JWST discoveries in the Early World is:

- The most secure oldest galaxy is GLASS-z13 ($z \approx 13$, light-travel distance of 13.4572 Byr) that has already built up $\sim 10^9 M_{\odot}$ in stars;
- The search of 88 candidate galaxies at $z > 11$ shows that some of them could be at redshifts as high as 20. Some of those distant galaxies are strikingly massive;
- Most of the early galaxies are nicely shaped, disklike galaxies;
- A new redshift record obtained for galaxy candidate CEERS-93316 at $z = 16.7$ (light-travel distance of 13.5512 Byr) with a stellar mass about $\sim 10^9 M_{\odot}$;
- Seven galaxies with $M^* > 10^{10} M_{\odot}$ and $7 < z < 11$ were found in the survey area, including two galaxies with $M^* \sim 10^{11} M_{\odot}$. The stellar mass density in massive galaxies is much higher than anticipated from previous studies: a factor of more than three orders of magnitude at $z \sim 10$;
- Extremely Compact Bright Galaxies were found at $z \sim 12$ –17;
- Super-early, massive, evolved galaxies with blue spectra, and very small dust attenuation.

WUM Explanation

These latest observations by JWST of the World can be explained in frames of WUM only:

- **It is a question of time!** The Beginning of the World was 14.22 Byr ago! Dark Epoch, when only DM Macroobjects existed, lasted for 0.45 Byr. Luminous Epoch exists ever since for 13.77 Byr;
- Early-galaxies formed in near present configuration as the result of transition from Dark Epoch to Luminous Epoch due to the Explosive Volcanic Rotational Fission of Overspinning DM Supercluster's Cores and self-annihilation of DMPs. Ordinary Matter is a byproduct of DMPs self-annihilation. There are no protogalaxies in the World. That is why JWST did not see their images;
- Compact Disk Galaxies emerged as the result of the Rotational Fission of the overspinning DM Core of Superclusters. Each of them have one DM Core. There are no frequent mergers of galaxies at the early epoch;
- According to Standard Cosmology, massive mature disk galaxies with mass up to $M^* \sim 10^{11} M_{\odot}$ cannot form so soon because it takes billions of years to form them, and so should not be there at all at the 'beginning';
- We hope that oldest galaxies with high-redshifts $z > 20.4$ (light-travel distance > 13.7 Byr) will be confirmed. It depends on the physical parameters of JWST.

Disk Galaxies

The experimental observations of galaxies in the World show that most of them are disk galaxies, which can be explained the following way. Galaxies emerged due to the Explosive Volcanic Rotational Fission of Overspinning DM Superclusters' Cores. 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 Interstellar Medium with low viscosity made of DMF3 with dissolved other DMPs. "Albumen" adds up to 2/3 of the total galaxy Matter;
- "Membrane" – boundary between Interstellar Medium and Intergalactic Medium with surface energy density $\sigma_0 = hc/a^3$ (h is Planck constant, c is a gravitodynamic constant, and a is a basic size unit $a = 1.7705641 \times 10^{-14} m$);
- ESS emerge due to the Explosive Volcanic Rotational Fission of Overspinning DM galaxy Core and enter Interstellar Medium. As a result, galaxy Bubble expands in the plane of the spinning galaxy's DM Core and becomes a Disk Bubble.

Conclusion

In the first Presentation, I named **Three main Pillars** of WUM: Medium of the World, Dark Matter, and Angular Momentum, which is one of the most critical problems in Standard cosmology that must be solved. Hypersphere World-Universe Model is the only one cosmological model in existence that is consistent with the **Law of Conservation of Angular Momentum**. The described picture of the World is, in fact, a Paradigm Shift for Cosmology.

Astronomers have great achievements in investigations of Macrostructures of the World. We are at the Beginning of a New Era of Astronomy, Cosmology, and Astrophysics! Young physicists should be a part of It. They should concentrate their efforts on the development of a New Cosmology and Classical Physics. I am very excited about the Future of Physics!

Presentation 4. Milky Way Galaxy [23][27][38]

Dark Matter Non-Acceptance, why?

*The basic feeling of many physicists is that Dark Matter (DM) does not exist because they believe that the DM construct was erroneously created due to a false analysis of the expected rotational velocity of stars in the outer range of spiral galaxies and also **presumably due to a lack of knowledge about other evidence for DM** (N. Percival). It is worth noting that in frames of World-Universe Model (WUM), there is no need in DM to explain galaxy rotation curves.*

The main results of the second Presentation “Multicomponent Dark Matter” are:

- Critical energy density of the World, which provides Its flatness, can be found by the Hubble’s law only. There is no need in General Relativity;
- Medium consists of stable elementary particles: protons, electrons, photons, neutrinos, and Dark Matter Particles (DMPs). The relative energy density of Ordinary particles – about 4.8% in the Medium (which was experimentally measured by Fast Radio Bursts), 2.4% in Macroobjects (MOs), and the rest 92.8% is the relative energy density of DMPs (what else it could be?).

In WUM, there is no Dark Energy, which is an unknown form of energy that affects the universe on the largest scales. Its primary effect is to drive an erroneously created accelerating expansion of the universe, contributing 68% of the total energy. The nature of dark energy is more hypothetical than that of dark matter, and many things about it remain in the realm of speculation.

In my previous Presentation “Angular Momentum”, D. De Hilster wrote the following comment: *The word “dark” is the canary in the coal mine that screams something fundamentally wrong with modern Cosmology. It does not exist. It is artifact of failed theory.*

At the same time, N. Percival said that DM WUM *is really empirically driven model rather than someone doing mathematical manipulation.*

The host of the session I. Cowan asked the perfect question that demonstrated his deep understanding of the multicomponent DM: *Do you conceive of DM as being analogous in atomic constitution to ordinary matter?*

There are principally different opinions about DM, why? In my opinion, there are two different issues with DM: Dark Matter Objects (DMOs) and Dark Matter Particles (DMPs). Usually, DMOs are accepted because the existence of them is experimentally proved. 240 years ago J. Michell predicted binary systems, in which a "dark star" and a normal star orbit around their center of mass, and they were identified by astronomers in 1971 (188 years later). Binary Galaxy systems including Dark Galaxies, were discovered – by R. Giovanelli and M. Haynes in 1989 and by R. Minchin, *et al.* in 2000.

In 1933, F. Zwicky investigated the velocity dispersion of Coma supercluster and found a surprisingly high mass-to-light ratio (~ 500). He concluded: *If this would be confirmed, we would get the surprising result that dark matter is present in much greater amount than luminous matter.* Masses of superclusters can be estimated by gravitational lensing also.

The main issue is with DMPs, for which there are no direct observations. They have no electrical charge and cannot be investigated by mass spectrometry. I would like to stress that there are many particles without electrical charge (Neutron, Neutrinos, Gluon, Higgs Boson, etc.). Nevertheless, we accept them without direct observations. Why do we have so much prejudice against DMPs?

Indirect effects in cosmic rays and gamma-ray background from the **annihilation of Cold DM** in the form of heavy stable neutral leptons in Galaxies were considered in pioneer article by Nobel Laureates in Physics B. W. Lee and S. Weinberg in 1977.

WUM follows this idea and introduces a multicomponent system of self-annihilating DMPs that behave like Majorana fermions, which are their own antiparticles.

In 1952, Nobel Laureate in Physics Y. Nambu proposed an empirical mass spectrum of elementary particles with a mass unit $m_0/2$ close to one quarter of the mass of a pion ($m_0/2 \cong 35 \text{ MeV}/c^2$). He noticed that meson masses are even multiples of a mass unit $m_0/2$, baryon (and also unstable lepton) masses are odd multiples, and mass differences among similar particles are quantized by $m_0 \cong 70 \text{ MeV}/c^2$. In WUM, I introduced a Basic Energy unit E_0 that equals to:

$$E_0 = hc/a = 70.025252 \text{ MeV}$$

where h is the Planck constant, c is the electrodynamic constant, and a is a Basic Size unit:

$$a = 1.7705641 \times 10^{-14} \text{ m}$$

I emphasize that the rest energy of electron E_e equals to: $E_e = \alpha E_0$ and the Rydberg unit of energy equals to: $Ry = hcR_\infty = 0.5\alpha^3 E_0 = 13.605692 \text{ eV}$ (R_∞ is the Rydberg constant).

It is the **main goal of WUM** to develop a Model based on two dimensionless parameters only:

- Dimensionless Rydberg constant $\alpha = (2aR_\infty)^{1/3}$ that named now Fine-structure constant;
- Dimensionless time-varying quantity Q that is a measure of the Size R and Age A_τ of the World ($Q = R/a = A_\tau/t_0$, where $t_0 = a/c = 5.9059662 \times 10^{-23} \text{ s}$ is a basic time unit), which in present epoch equals to the value $Q = 0.759972 \times 10^{40}$ and is, in fact, the Dirac Large Number.

Considering the main goal of WUM, the rest energies of DMPs should be proportional to constant α only. WUM postulates that rest energies of Dark Matter Fermions (DMFs) and bosons are proportional to the basic energy unit E_0 multiplied by different exponents of α and can be expressed with the following formulae:

Table 1. Dark Matter Particles.

Fermion			Boson		
Particle	Rest Energy	Value	Particle	Rest Energy	Value
DMF1	$\alpha^{-2}E_0$	1.3149948 <i>TeV</i>	DIRAC	$\alpha^0 E_0$	70.025252 <i>MeV</i>
DMF2	$\alpha^{-1}E_0$	9.5959804 <i>GeV</i>	ELOP	$2/3\alpha^1 E_0$	340.66596 <i>keV</i>
DMF3	$\alpha^2 E_0$	3.7289394 <i>keV</i>	XION	$1/2 \alpha^6 E_0$	5.2870895 μeV
DMF4	$\alpha^4 E_0$	0.19857107 <i>eV</i>			

In our view, this Created Table of DMPs, covering 18 orders of magnitude of rest energies, is the *analogous in atomic constitution to ordinary matter*, as I. Cowan said in the previous Presentation.

The reason for this multicomponent DM system is to explain:

- The diversity of Very High Energy (VHE) gamma-ray sources in the World. In Presentation 2, we discussed experimental confirmations of the proposed DMPs in VHE gamma spectra;
- The diversity of DM Cores of Macroobjects of the World: Extrasolar Systems (DMF1 and DMF2), Galaxies (DMF3), Superclusters (DMF4), which are Fermion Compact Objects and DM Reactors in WUM. In Presentation 3, we discussed Macrostructures of the World with these DM Cores;
- DMF4 are responsible for Unidentified Infrared Emission Bands (main infrared features occur around peaks at 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm), which are “Fingerprints” of all galaxies;

- DIRACs, which are magnetic dipoles of Dirac's monopoles, are introduced to explain the Dirac's quantization condition – all electric charge in the universe must be quantized;
- ELOPs, which are dipoles of preons with electrical charge $e/3$, are the building blocks for Quarks;
- XIONs are responsible for Le Sage's mechanism of gravitation and broadband 21-cm Emission.

Introduction

“*The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy*” (Nobel Prize in Physics 2020) made by R. Genzel and A. Ghez is a confirmation of one of the most important predictions of WUM in 2013: “*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*”. I would like to stress that R. Genzel and A. Ghez named the Object **Supermassive Compact Object** but not supermassive black hole as it was only accepted explanation. There are no black holes in WUM.

Recently a population of large, very low surface brightness, spheroidal galaxies was identified in the Coma cluster. P. van Dokkum, *et al.* (2019) present the stellar kinematics of Dragonfly 44, one of the largest Coma **Ultra Diffuse Galaxies**, whose mass about equals that of the Milky Way (MW). However, the galaxy emits only 1% of the light emitted by MW. Astronomers reported that this galaxy might be made almost entirely of DM. The existence of **nearly-dark objects** with this mass is unexpected, as galaxy formation is thought to be maximally-efficient in this regime.

R. K. Leane and T. R. Slatyer (2019) in the article “*Revival of the Dark Matter Hypothesis for the Galactic Center Gamma-Ray Excess*” examine the impact of unmodeled source populations on identifying the true origin of the galactic center GeV excess. The authors discover striking behavior consistent with a mismodeling effect in the real Fermi data, finding that large artificial injected DM signals are completely misattributed to point sources. Consequently, they conclude that **DM may provide a dominant contribution to the galactic center GeV excess** after all.

On May 12, 2022, astronomers, using the Event Horizon Telescope, released the first image of the accretion disk around the Sagittarius A* (Sgr A*) produced using a world-wide network of radio observatories made in April 2017. These observations were analyzed by an international research team that now numbers over 300 people, which claimed that Sgr A* is a Supermassive Black Hole.

Below, we analyze these results in frames of WUM. Based on the totality of all accumulated results for the Center of MW, I conclude that Sgr A* is the DM Core of our Galaxy.

WUM solves a number of physical problems in contemporary Cosmology and Astrophysics through DMPs and their interactions: Angular Momentum problem in birth and subsequent evolution of Galaxies and Extrasolar Systems – how do they obtain it (we discussed this problem in the previous Presentation 3) and Fermi Bubbles (which are two large structures in gamma-rays above and below Galactic center) – what is a mechanism of their radiations. We will discuss it below.

World-Universe Model

Macrostructures

Laniakea Supercluster (LSC) is a galaxy supercluster that is home to MW and $\sim 10^5$ other nearby galaxies (see **Figure 1** and **Figure 2**). It is known as one of the largest superclusters with estimated by L. Bliss (2014) binding mass $10^{17} M_{\odot}$. Distance to the Centre of LSC is about 250 Mly. We emphasize that $\sim 10^5$ nearby galaxies are moving around Centre of LSC. They belong to LSC. All these galaxies did not start their movement from "Initial Singularity". Neighboring superclusters have the same structure.

It means that the World is, in fact, a Patchwork Quilt of main Superclusters.

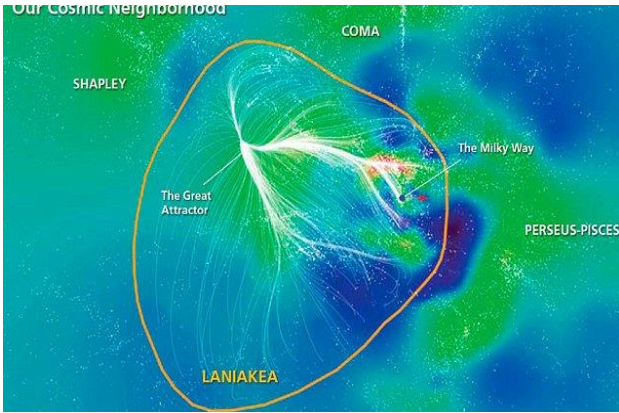


Figure 1. Laniakea Supercluster. Adapted from the article by Tully, R. B., *et al.* (2014).

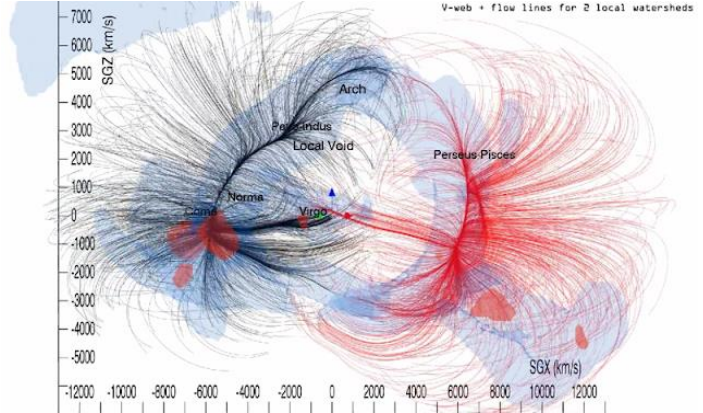


Figure 2. A representation of structure and flows due to mass within $6,000 \text{ km s}^{-1}$ ($\sim 80 \text{ Mpc}$). Adapted from the article by Tully, R. B., *et al.* (2014).

Macroobject Shell Model

In WUM, Macrostructures of the World (Superclusters, Galaxies, Extrasolar systems) have Nuclei made up of Dark Matter Fermions (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. We discussed this Model in Presentation 2.

Table 2 describes parameters of MOs' Cores, which are 3D fluid balls with a very high viscosity and function as solid-state objects, calculated based on the developed theory of Fermion Compact Objects.

Table 2. Parameters of Macroobjects' Cores made up of different Fermions in present Epoch.

Fermion	Rest Energy, MeV	Macroobject Mass M_{max}, kg	Macroobject Radius R_{min}, m	Macroobject Density, 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 (ESS);
- 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.

Formation of Macrostructures

In frames of WUM:

- LSC emerged 13.77 Byr ago due to a random Explosive Volcanic Rotational Fission (RF) of a Supercluster

Overspinning (surface speed at equator exceeding escape velocity) DM Core and self-annihilation of DMPs. DM Core of LSC was created during Dark Epoch (spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr) when only DM MOs existed;

- DM Core of MW was born 13.77 Byr ago as the result of RF of Virgo Supercluster DM Core;
- DM Cores of ESS, planets and moons were born as a result of the repeating RFs of Milky Way DM Core in different times (4.57 Byr ago for the Solar System);
- Macrostructures of the World form from the top (superclusters) down to galaxies, ESS, planets, and moons. In our view, random Explosive Volcanic Rotational Fission of DM Core of Prime Object 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 the angular momentum of the Prime Object. DM Cores of Prime Objects detonate at critical points of their stability, which **principally depend on the accumulated Rotational Angular Momenta** (we discussed it in Presentation 3).

Milky Way

MW is a barred spiral galaxy which is a part of the Local Group of galaxies that form part of the Virgo Supercluster, which is itself a component of LSC. The age of MW and the oldest star HD 140283 (named Methuselah) is similar to the Age of the World. The galactic center is an intense radio source known as Sgr A*. In 2008, A. M. Ghez, *et al.* found the enclosed mass of It: $(4.1 \pm 0.6) \times 10^6 M_{\odot}$.

I emphasize that now with JWST we are looking for the earliest and most distant galaxies, and at the same time, **we live in one of the earliest galaxies – Milky Way!** According to Standard Cosmology, massive mature disk galaxies with mass up to $M^* \sim 10^{11} M_{\odot}$ cannot form for the amount of time (100 – 400) *Myr*, because it takes Byrs to form them. So they should not be there at all!

The experimental observations of galaxies in the World show that most of them are disk galaxies. MW is the second-largest spiral galaxy in the Local Group (after Andromeda Galaxy), with its estimated visible stellar disk diameter

$$D_{MW} = 185 \pm 15 \text{ kly}$$

thickness of thin stellar disk about 2 *kly* and mass

$$M_{MW} = (1.6 - 3.2) \times 10^{42} \text{ kg}$$

In our view, MW is a Disk Bubble whose boundary with the Intergalactic Medium has a basic surface energy density σ_0 that equals to:

$$\sigma_0 = hc/a^3$$

The Disk Bubble contains Interstellar Medium (ISM) and (100 – 400) billion ESS.

With Nikola Tesla's principle at heart – *There is no energy in matter other than that received from the environment* – we calculate mass M_{MW} according to the equation:

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

From this equation, we calculate D_{MW} :

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

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

- Mass of MW :

$$M_{MW} = 1.92 \times 10^{42} \text{ kg}$$

- Average concentration of DM particles DMF3 in ISM :

$$n_{DMF3} = 3.04 \times 10^{11} m^{-3}$$

which is significantly larger than the critical concentration n_W^{cr} that defines Weak interaction:

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

It means that Weak interaction between DM particles DMF3 provides integrity of MW disk bubble.

Andromeda Galaxy (AG) is a barred spiral galaxy $\cong 2.5 Mly$ from the Earth and the nearest large galaxy to MW with $\sim 10^{12}$ stars. It has an estimated visible stellar disk diameter ~ 220 kly and mass $(3 \pm 1) \times 10^{42} kg$. 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 too.

Considering the fact that the calculated concentration of DMF3 is significantly larger than the critical concentration, we can suppose that our conclusions for MW are fair for all galaxies in World.

In 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 eggs” 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.

Center of Milky Way

Sagittarius A* (Sgr A*) is a **supermassive black object** at the Galactic Center of MW, which was discovered in 1954 by J. D. Kraus, H-C. Ko, and S. Matt with radio telescope at 250 MHz . It is a **bright and very compact astronomical radio source**. In 1982, R. L. Brown understood that the strongest radio emission from the center of MW appeared to be due to a **compact nonthermal radio object**.

The Sagittarius A* cluster is the cluster of stars in close orbit around Sgr A*. One of the most studied stars is S2. Star S14 is the record holder of closest approach to Sgr A*, at $\sim 1.88 \times 10^{12} m$, almost as close as Saturn gets to the Sun. Its orbital period is 12 years, but an extreme eccentricity of 0.985 gives it the close approach and high velocity of about 8% of the speed of light.

In 2005, F. Eisenhauer, *et al.* reported the results (with 75 milli-arcsec resolution) of **near-IR** imaging spectroscopy within the central 30 light days of the Galactic Center (see **Figure 3**).

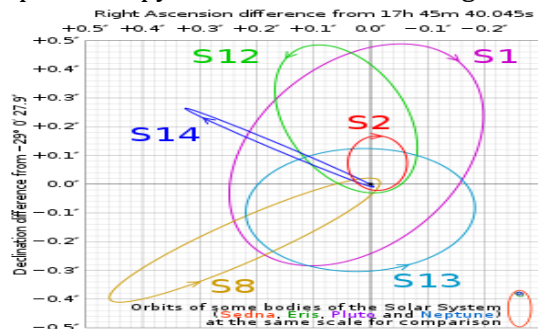


Figure 3. Inferred orbits of 6 stars around Sgr A* at MW center.

On January 5, 2015, NASA reported observing from Sgr A* a record-breaker X-ray flare 400 times brighter than usual. According to astronomers, the unusual event may have been caused by the breaking apart of an asteroid falling into Supermassive Black Hole (can you believe it?).

In 2018, S. D. von Fellenberg, *et al.* reported the first detection of the Galactic Centre in the far infrared. Their measurements were obtained at 100 μm and 160 μm .

In 2019, the observations of several stars orbiting Sgr A* have been used to determine the mass and upper limits on the radius of the object. Based on mass and increasingly precise radius limits, astronomers have found that the enclosed mass of Sgr A* is $(4.154 \pm 0.014) \times 10^6 M_{\odot}$ (compare with $(4.1 \pm 0.6) \times 10^6 M_{\odot}$ obtained by A. M. Ghez, *et al.* in 2008). A calculated Schwarzschild radius of its mass $1.227 \times 10^{10} m$ is about two orders of magnitude smaller than the minimum distance of star S14 from Sgr A*: $1.88 \times 10^{12} m$.

On 2021, NASA published new images of the galactic center, based on surveys from Chandra X-ray Observatory. Astronomers present a catalogue of the detected X-ray sources in the 0.3-7 keV band. NASA has released a stunning new picture of our galaxy's violent, super-energized "**downtown**." The image, a composite of 370 observations made over the past two decades, depicts billions of stars in the center of MW. The author D. Wang said: "*What we see in the picture is a violent or energetic ecosystem in our galaxy's downtown*".

WUM Explanation (see Table 2):

- The calculated value of the radius of the Electron-Positron shell $2.9 \times 10^{10} m$ is in excellent agreement with experimentally measured value of the radio source $3 \times 10^{10} m$ by Lu, R., *et al.*;
- The calculated value of the mass of the Electron-Positron shell $6.6 \times 10^{36} kg$ is in good agreement with the experimentally measured value of the supermassive compact object $8.5 \times 10^{36} kg$ by Ghez, A. M.; *et al.* (2008);
- The additional mass of the DMF3 shell of $1.9 \times 10^{36} kg$ is much smaller than the maximum mass of it: $1.2 \times 10^{41} kg$;
- X-ray flare 400 times brighter than usual, observed by F. Chou, *et al.* (2015), can be explained by the detonation of DMF3 particles (3.7 keV) and their self-annihilation;
- The excess of gamma-ray emission with energy about 10 GeV reported by D. Hooper (2011) from the Galactic Center can be explained by DMF2 particles (9.6 GeV) self-annihilation;
- The age of the Methuselah: $14.46 \pm 0.8 \text{ Byr}$, found by H. E. Bond, *et al.* (2013), can be explained by generation of this star by overspinning Core of MW 13.77 billion years ago;
- In frames of the Rotational Fission model, it is easy to explain hyper-runaway stars unbound from MW with speeds of up to $\sim 700 \text{ km/s}$ [Marchetti, T., *et al.* (2018)]: they were launched by overspinning DM Core of Large Magellanic Cloud with the speed higher than the escape velocity;
- S. E. Koposov, *et al.* (2019) present the discovery of the fastest Main Sequence hyper-velocity star S5-HVS1 with mass of about 2.3 solar mass that is located at a distance of $\sim 9 \text{ kpc}$ from the Sun. When integrated backwards in time, the orbit of the star points unambiguously to the Galactic Centre, implying that S5-HVS1 was kicked away from Sgr A* with a velocity of $\sim 1800 \text{ km/s}$, and travelled for 4.8 Myr to its current location. This discovery can be explained by Gravitational Burst of the overspinning Core of MW 4.8 Myr ago, which gave birth to S5-HVS1 with a speed higher than the escape velocity of a MW Core;
- C. J. Clarke, *et al.* (2018) observed CI Tau, a young 2 Myr old star, which is located about 500 light years away. They discovered that ESS contains four gas giant planets that are only 2 Myr old, an amount of time that is too short for formation of gas giants according to the prevailing theories. This discovery can be explained by Gravitational Burst of the MW Core 2 Myr ago, which gave birth to the CI Tau system with all the planets generated at the same time.

Observations by Event Horizon Telescope Collaboration

In May 2022, Collaboration presented Event Horizon Telescope 1.3 mm measurements of the radio source located at the position of the supermassive black object Sgr A*, collected during the 2017 April campaign (see Figure 4). A deciphered image of Sgr A* is depicted in Figure 5.

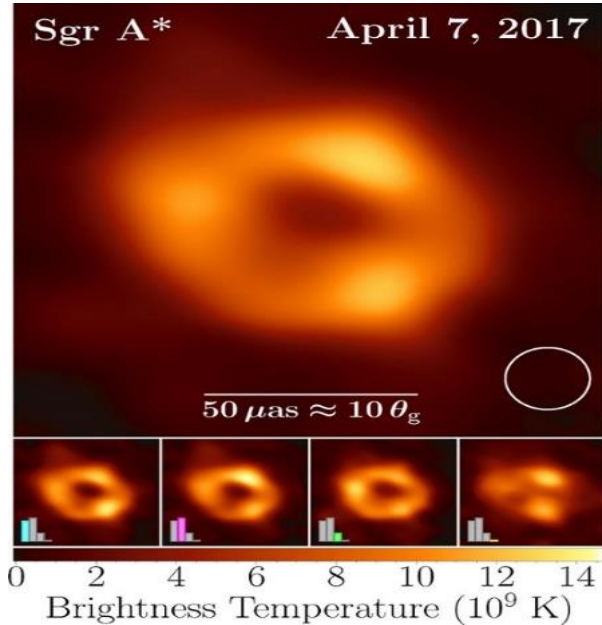


Figure 4. Sagittarius A* imaged by the Event Horizon Telescope in 2017, released in 2022. Adapted from the article by G. C. Bower (Project Scientist) (2022).

The observations were conducted with eight facilities at six locations across the globe. Novel calibration methods are employed to account for Sgr A*'s flux variability. A few teams of researchers have attempted to image Sgr A* in the radio spectrum using very-long-baseline interferometry. The current highest-resolution ($\sim 30 \mu\text{as}$) measurement, made at a wavelength of 1.3 mm, indicated an overall angular size for the source of $50 \mu\text{as}$. At a distance of 26.673 kly this yields a diameter of $6.337 \times 10^{10} \text{ m}$.

Multiwavelength monitoring of Sgr A* was performed at 22, 43, 86 GHz and at near-infrared and X-ray wavelengths. Several X-ray flares from Sgr A* are detected by Chandra, one at low significance jointly with Swift on 2017 April 7 and the other at higher significance jointly with NuSTAR on 2017 April 11. The Collaboration compared Sgr A*'s broadband flux during this campaign to its historical spectral energy distribution and found that both the quiescent emission and flare emission are consistent with its long-term behavior.

Astronomers of the Collaboration have made a first comparison of the 2017 Sgr A* data to a state-of-the-art library of ideal time-dependent General Relativistic Magnetohydrodynamics simulations models. The models assume that the mass and distance to Sgr A* are known and that the **central object is a rotating uncharged Supermassive Black Hole (SBH)**.

None of the fiducial models survive the full gauntlet of 11 constraints. The astronomers set aside both variability constraints and got two fiducial models that pass the remaining nine constraints in all simulation pipelines. These models in the "best-bet region" are strongly magnetized and have **positive spin** and low inclination.

Based on the obtained results the Event Horizon Telescope Collaboration claimed that Sgr A* is a Supermassive Black Hole. Below we analyze the obtained experimental results in frames of WUM.

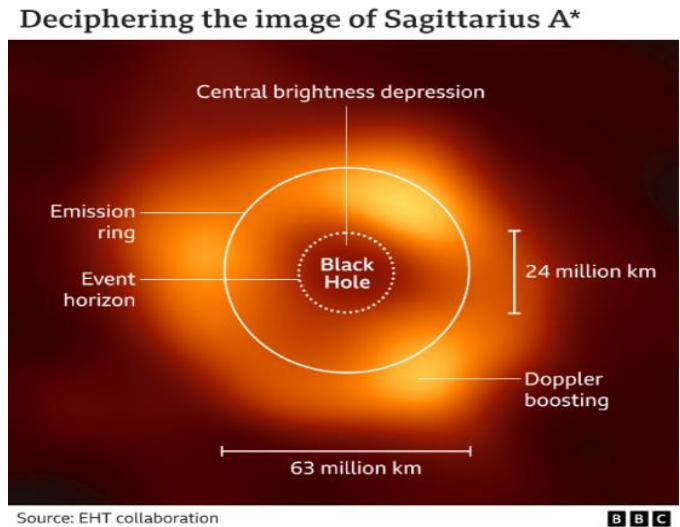


Figure 5. The Milky Way's monster black hole seen for the FIRST time. Adapted from the article by Athens Bureau (2022).

Analysis of Event Horizon Telescope Results

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

- The age of MW is similar to the Age of the World. The oldest star in MW (named Methuselah) is nearly as old as the World itself. If Sgr A* is a SBH, then how it could grow so quickly?
- What is the origin of the alleged SBH positive spin?
- Their models in the "best-bet region" have low inclination 30° and 10° that contradicts the disk shape of MW and bipolar astrophysical jets (which are astronomical phenomena where outflows of matter are emitted as the extended beams along the axis of rotation [Beall, J.H. (2015)]);
- The MW galaxy (including Sgr A*) is gravitationally bounded with Virgo Supercluster (VS) and has a huge orbital angular momentum calculated based on the distance of 65 million light- years from VS and orbital speed of about 400 km/s [NASA (2015)]. How did MW galaxy obtain this very large orbital angular momentum?
- What is the mechanism of gamma rays emission from the Galactic Center?

In frames of **WUM Macroobjects Shell Model** (which we discussed in Presentation 3), the results obtained by the Event Horizon Telescope Collaboration can be explained in the following way:

- The image is dominated by the bright, thick ring with the diameter of $6.337 \times 10^{10} m$. The ring has a comparatively dim Interior that is made up of DM Fermions DMF1 (1.3 TeV) and DMF2 (9.6 GeV), which are responsible for the excess of gamma-ray emission from Sgr A* due to their self-annihilation;
- DMPs are continuously absorbed by the Interior of the Sgr A*. Ordinary Matter is a byproduct of DMPs self-annihilation. It is re-emitted by the Interior continuously into the Shell around it;
- Very powerful gamma quants with energy of at least 1.02 MeV in the vicinity of atomic nuclei of the Shell produce electron-positron pairs with high concentration;
- The bright, thick area with the diameter of $6.337 \times 10^{10} m$ consists of Ordinary Matter and Electron-Positron plasma with the radius of $2.9 \times 10^{10} m$ that is a compact **nonthermal radio object** responsible for the strongest radio emission from the center of MW;
- The area from the radius of $3.17 \times 10^{10} m$ to $1.88 \times 10^{12} m$ is filled out with DM Fermions DMF3 (3.7 keV), which are responsible for X-rays from the center of MW due to their self-annihilation. The 400 times brighter than usual X-ray flare reported by NASA is the result of the detonation process inside of this shell, which does not destroy it; instead, Hyper-flare occurred in active region of the shell, analogous to Solar flares;
- The enclosed mass of Supermassive Compact Object of $4.154 \times 10^6 M_\odot$ is the mass of the MW DM Core made up of DMF1 and DMF2 with Electron-Positron shell and DMF3 shell;
- Sgr A* has gotten the rotational and orbital angular momenta as the result of the rotational fission of the DM Core of the Virgo Supercluster.

The totality of all obtained experimental results testify in favor of the existence of the supermassive compact object made up of Dark Matter particles at the Milky Way Center.

Dark Matter Fermi Bubbles

In 2010, the discovery of two Fermi Bubbles (FBs) emitting gamma- and X-rays was announced. FBs extend for about 25 kly above and below the center of the galaxy [M. Su, T. R. Slatyer, and D. P. Finkbeiner (2010)]. 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 remains unconstrained up to around 1 TeV

[Yang, L. and Razzaque, S. (2019)]. **Years after the discovery of FBs, their origin and the nature of the gamma-ray emission remain unresolved.**

M. Su and D. P. Finkbeiner (2012) identify a gamma-ray cocoon feature in the southern Fermi Bubble, a jet-like feature along the cocoon's axis of symmetry, and another directly opposite the Galactic center in the north. 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.* (2019) 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 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 (2013) discuss two emission mechanisms in 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 and L. Goodenough (2011) 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, T. Jeltema, and S. Profumo (2018) calculated the expected emission across the electromagnetic spectrum in comparison with available observational data from M31 and found that the best fitting models are with the DMP mass 11 GeV.

According to H.-Y. K. Yang, M. Ruszkowski, and E. G. Zweibel (2018) for **understanding the physical origin of FBs**, three major questions need to be answered:

- First, what is the emission mechanism? The bubbles can either be hadronic, where the gamma rays are produced by inelastic collisions between cosmic-ray protons and the thermal nuclei via decay of neutral pions, or leptonic, where the gamma rays are generated by inverse-Compton scattering of the interstellar radiation field by cosmic-ray electrons;
- Second, what activity at the Galactic Center triggered the event – are the bubble associated with nuclear star formation or active galactic nucleus activity?
- Third, where are the Cosmic rays accelerated? They could either be accelerated at the Galactic Center and transported to the surface of the bubbles or accelerated in-situ by shocks or turbulence. Note however that not all combinations of the above three considerations would make a successful model because of **constraints given by the hard spectrum** of the observed bubbles.

WUM Explanation of Fermi Bubbles

WUM explains FBs the following way:

- Core of Milky Way galaxy is made up of DM particles: 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 of DMPs are ejected from the rotating DM Core of MW 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, which were discussed by M. Su and D. P. Finkbeiner. The prominent X-ray structures on intermediate scales (hundreds of parsecs)

above and below the plane (named by Ponti, G., *et al.* the Galactic Centre ‘chimneys’), are the result of the self-annihilation of DMF3;

- FBs are bubbles whose boundary with the Intergalactic Medium has a basic surface energy density σ_0 . These bubbles are filled with DM particles: DMF1, DMF2, and DMF3. FBs are Macroobjects 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. In WUM, the diameter of FBs equals to:

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

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 by Aguilar, D.A. and Pulliam, C. and 32.6 kly by G. Ponti, *et al.* Weak interaction between DMF3 particles provides integrity of Fermi Bubbles;

- With Nikola Tesla’s principle at heart – *There is no energy in matter other than that received from the environment* – we calculate the mass M_{FB} :

$$M_{FB} = \frac{\pi D_{FB}^2 \sigma_0}{c^2} = \frac{\pi h}{\alpha^4 a c} \times Q^{3/2} \cong 3.6 \times 10^{41} \text{ kg}$$

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

- FBs radiate X-rays due to the self-annihilation of DMF3 (3.7 keV). Gamma rays up to 1 TeV are the result of self-annihilation of DMF1 (1.3 TeV) and DMF2 (9.6 GeV) in Dark Matter Objects (DMOs) whose density is sufficient for the self-annihilation of DMPs to occur. On the other hand, DMOs 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;
- A total flux of the gamma radiation from FBs is a sum of the contributions of all individual DMOs, which irradiate gamma quants with different energies and attract new DMF1 and DMF2 from FBs;
- The Core of MW supplies FBs with new DMPs through the galactic wind, explaining the brightness of FBs remaining fairly constant during the time of observations. In our opinion, FBs are built continuously throughout the lifetime of the Milky Way galaxy.

Fermi Bubbles made up of DMF3 particles resemble a honeycomb filled with DMF1 and DMF2.

Conclusion

The totality of all obtained experimental results testify in favor of the existence of supermassive compact object made up of DMPs at the Milky Way Center and validate the developed World-Universe Model. In our view, Fermi Bubbles are DMPs clouds containing uniformly distributed Dark Matter Objects, in which DMPs self-annihilate and radiate gamma rays with energies covering 9 orders of magnitude (from keV to TeV). DM Fermi Bubbles constitute principal proof of WUM.

Acknowledgements

I am always grateful to Academician A. Prokhorov and Prof. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father P. Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to N. Tesla who was a genius. I am much obliged to Prof. C. Corda for publishing my [manuscripts](#) in the Journal of High Energy Physics, Gravitation and Cosmology. I am grateful to N. Percival for his useful comments and suggestions, which have led to an overall improvement of the Presentation. Special thanks to my son Ilya Netchitailo who helped me clarify the Model.

Presentation 5. Solar System [13][21][32][39]

Dark Matter Concept

Considering your comments in the previous Presentation and the private communication with H. Ricker, I rethought the concept of "Dark Matter" and came to the point that this concept is not exactly what I mean about new kind of Matter in frames of World-Universe Model (WUM).

In WUM, Dark Matter is not "dark" at all. It was dark 240 years ago when J. Michell proposed "Dark Stars" and astronomers had only telescopes. They observed the sky with their eyes only! For them, Dark Stars were dark! The first known binary system was Cygnus X-1 that is typically the brightest persistent source of **hard X-rays with energies up to 60 keV**. In 2000, R. Minchin, *et al.* discovered binary galaxy system VIRGOHI 21 with NGC 4254, which has the **21-cm emission**. They are not "dark" because the contemporary Astronomy allows us to observe the sky in wavelengths from radio waves up to gamma rays!

In my previous Presentations, I followed the standard paradigm "Dark Matter" that is not quite right for WUM, in which the World consists of particles of Ordinary Matter: protons, electrons, photons, and neutrinos. On the other hand, there are particles created by the Universe – Universe- Created (UC) Particles of a new kind of Universe-Created Matter (UCM), which have following characteristics: **Fermions or Bosons, Rest Energies**, covering eighteen orders of magnitude, **Weak Interaction**, and **Self-annihilation** like Majorana fermions. Ordinary particles are a byproduct of UC Particles self-annihilation. It is easy to switch from Dark (D) to Universe-Created (UC) Matter.

In WUM, the Nucleus of the World (4D Ball) is Expanding in the fourth spatial dimension with speed c (gravitodynamic constant) and the World (3D Hypersphere) is Stretching. The Eternal Universe is the Creator of UC Matter in 4D Nucleus. UC Particles carry new UC Matter into the World. It is important to emphasize that continuous Creation of Matter is direct consequence of the Nucleus expansion. Creation of UC Matter occurs homogeneously in all points of Hypersphere World.

WUM is not like the old Steady State theory, in which the density of Matter in the expanding universe remains unchanged due to a continuous creation of Matter. In WUM, the density of Matter is going down inversely proportional to Cosmological Time.

The World consists of Medium and Macroobjects (MOs). Medium is some kind of Aether, made of ordinary particles and UC Particles, with very low density $\sim 10^{-26} \text{ kg/m}^3$ in Present Epoch. Total density of the World equals to a critical energy density throughout the World's evolution. It provides a **Flatness** of the World. The energy density of Medium is 2/3 of the total energy density and MOs (Superclusters, Galaxies, Extrasolar Systems)– 1/3 in all cosmological times. Relative energy density of UC Particles is about 92.8% and Ordinary particles – about 4.8% in the Medium and 2.4% in MOs.

I stress that the content of all particles is the same in the Medium and MOs, but in the Medium the density of them is the same (the Medium is homogeneous) and in MOs – there are Cores made of UC Fermions and Shells of all other particles around them (like "Hills").

Introduction

Solar System (SS) is a gravitationally bound system of the Sun and the objects that orbit it. It formed 4.57 Byr ago. The vast majority of SS mass is in the Sun, with most of the remaining mass contained in the Jupiter. The four inner system planets—Mercury, Venus, Earth, and Mars—are terrestrial planets. The four giant planets of outer system – Jupiter, Saturn, Uranus, and Neptune – are substantially larger than the terrestrials. **All eight planets have nearly circular orbits that lie near the plane of Earth's orbit, called the ecliptic.**

There are unknown number of smaller **Dwarf planets** and innumerable small SS bodies orbiting the Sun. Six largest possible dwarf planets, and many of the smaller bodies are orbited by natural satellites, commonly called "moons" after Earth's Moon.

Asteroid belt, which lies between the orbits of Mars and Jupiter, contains objects composed of rock, metal, and ice. About 60% of the main belt mass is contained in the four largest asteroids: Ceres, Vesta, Pallas, and Hygiea. The total mass of the asteroid belt is about 3% that of the Moon.

Beyond Neptune's orbit lie the **Kuiper belt** that is a **circumstellar disc** in the outer SS, extending from the orbit of Neptune at 30 AU to approximately 50 AU from the Sun. Most Kuiper belt objects are composed largely of frozen volatiles, such as methane, ammonia, and water. The Kuiper belt is home to most of the objects that astronomers generally accept as dwarf planets: Makemake, Orcus, Pluto, Haumea, and Quaoar. The total mass of the Kuiper belt is $(1.97 \pm 0.30) \times 10^{-2}$ Earth mass.

Trans-Neptunian Objects (TNOs) are any minor planets in the SS that orbits the Sun at a greater average distance than Neptune. The first discovered in 1930 TNO was Pluto. The most massive TNO known is Eris, followed by Pluto, Haumea, Makemake, and Gonggong. More than 80 satellites have been discovered in orbit of TNOs. Twelve minor planets with a semi-major axis greater than 150 AU and perihelion greater than 30 AU are known, which are called extreme TNOs.

Oort cloud is a theoretical concept of a cloud of predominantly icy planetesimals proposed to surround the Sun at distances ranging from 1,000 to 100,000 AU. It is divided into two regions: a **disc-shaped inner Oort cloud** and a **spherical outer Oort cloud**. Both regions lie beyond **heliosphere** and are in **Interstellar space**. The **Inner cloud** is a vast **theoretical circumstellar disc**, whose outer border would be located at around 20,000 AU from the Sun. The outer edge of the **Outer cloud** might be about 100,000 AU from the Sun. Its total mass is not known, but roughly the combined mass is five times that of Earth. No known estimates of the mass of the inner Oort cloud have been published. Astronomers conjecture that the matter composing the Oort cloud formed closer to the Sun and was scattered far into space by the gravitational effects of the giant planets early in SS evolution.

There are two main classes of **Comets**: short-period comets (called ecliptic comets) and long-period comets (called nearly 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.

Facts about Planets and Moons

According to "Evolution Encyclopedia", there are the following facts that do not fit into any evolutionary theory of how our solar system came into existence:

- *A full 99.5 percent of all the angular momentum in the solar system is concentrated in the planets, yet a staggering 99.8 percent of all the mass in our solar system is located in our sun!*
- *Jupiter itself has 60 percent of the planetary angular motion. This strange distribution was the primary cause of the downfall of the nebular hypothesis (290 years old!).*
- *Both Uranus and Venus rotate backwards to that of all the other planets. Why then does Venus rotate slowly backwards, and Uranus rotate at a 98 degree angle from its orbital plane;*
- *One-third of the 60 moons in our solar system have retrograde (backward) orbits, which are the opposite of the rotational direction of their respective planets;*
- *There are such striking differences between planets and planets, planets and moons, moons and moons. If they all came from the same gas clouds, they should all be alike!*

Solar System in WUM

Let us consider rotational and orbital angular momentum of all gravitationally-rounded objects in SS, from Mimas, a small moon of Saturn ($3.75 \times 10^{19} \text{ kg}$), to the Sun itself ($2 \times 10^{30} \text{ kg}$). We calculated their angular momenta in the present Epoch (see **Table 1**).

Table 1. Value of Rotational and Orbital angular momentum of gravitationally-rounded objects in SS.

Object of Solar System	Rotational Momentum (J s)	Orbital Momentum (J s)	Object of Solar System	Rotational Momentum (J s)	Orbital Momentum (J s)
Sun	1.10E+42		Uranus	2.30E+36	1.70E+42
Mercury	9.75E+29	9.15E+38	Miranda	7.54E+25	5.67E+31
Venus	2.13E+31	1.85E+40	Ariel	5.22E+27	1.42E+33
Earth	7.09E+33	2.66E+40	Umbriel	2.88E+27	1.49E+33
Moon	2.36E+29	2.89E+34	Titania	7.28E+27	5.57E+33
Mars	2.10E+32	3.53E+39	Oberon	3.78E+27	5.54E+33
Jupiter	6.83E+38	1.93E+43	Neptune	2.72E+36	2.50E+42
Io	4.84E+30	6.53E+35	Triton	1.94E+29	3.33E+34
Europa	9.68E+29	4.42E+35	Pluto	8.42E+28	3.66E+38
Ganimede	4.18E+30	1.72E+36	Charon	2.52E+27	5.32E+30
Callisto	1.09E+30	1.66E+36	Ceres	1.62E+28	6.96E+36
Saturn	1.35E+38	7.82E+42	Haumea	4.65E+29	1.18E+38
Mimas	4.55E+25	9.96E+31	Eris	6.05E+29	6.12E+38
Enceladus	1.46E+26	3.25E+32			
Tethys	2.70E+27	2.06E+33			
Dione	3.67E+27	4.14E+33			
Rhea	8.67E+27	1.03E+34			
Titan	1.63E+30	9.16E+35			
Lapetus	3.58E+26	2.10E+34			

From the point of view of Rotational Fission model, the prime object is transferring some of its rotational momentum to orbital momentum of the satellite. It follows that **the rotational momentum of the prime object should exceed the orbital momentum of its satellite.**

From **Table 1** we see that orbital momenta of most satellites are indeed substantially smaller than the rotational momenta of their prime objects, with three exceptions:

- The rotational momentum of the Sun is smaller than Jupiter's, Saturn's, Uranus's, and Neptune's orbital momentum;
- The rotational momentum of the Earth is substantially smaller than Moon's orbital momentum;
- The rotational momentum of Pluto is considerably smaller than Charon's orbital momentum.

Considering that Jupiter's orbital momentum is about 60% of the total angular momentum of SS L_{tot}^{SS} , we obtain: $L_{tot}^{SS} \cong 3.2 \times 10^{43} \text{ J s}$. Let us calculate parameters of the overspinning (surface speed at equator exceeding escape velocity) Sun's Core necessary to provide this angular momentum. Considering mass of Sun $M_{Sun} = 2 \times 10^{30} \text{ kg}$ and radius $R_{Sun} = 7 \times 10^8 \text{ m}$, we obtain:

$$L_{rot}^{Sun} = 1.1 \times 10^{44} \text{ J s}$$

which is 3.3 times greater than L_{tot}^{SS} . It follows that the Sun's Core can be smaller.

Let us consider the structure of the Sun. According to the standard Solar model it has:

- Core that extends from the center to about 20–25% of the solar radius, contains 34% of the Sun's mass with density $\rho_{max} = 150 \times 10^3 \text{ kg/m}^3$ and $\rho_{min} = 20 \times 10^3 \text{ kg/m}^3$. It produces all Sun's energy;
- Radiative zone from the Core to about 70% of the solar radius with density $\rho_{max} = 20 \times 10^3 \text{ kg/m}^3$ and $\rho_{min} = 0.2 \times 10^3 \text{ kg/m}^3$, in which convection does not occur and energy transfer occurs by radiation;
- Core and Radiative zone contain practically all Sun's mass [Djorgovski, S. G. (2016)].

In our opinion, the Sun has an Inner Core (Nucleus made up of UCF1 (1.3 TeV)) whose radius is 20–25% of the solar radius, and an Outer Core, made up of UCM, – the Radiative zone. We then calculate the overspinning Solar Core rotational angular momentum L_{rot}^{SC} before Rotational Fission:

$$L_{rot}^{SC} \cong 8.9 \times 10^{43} \text{ J s}$$

which is 2.8 times larger than the overall angular momentum of SS.

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 [Cohen, H. (2001)], which is about the same power density inside a compost pile and closer approximates reptile metabolism than a thermonuclear bomb.

Let us follow the same procedure for Earth – Moon pair. Considering the mass of Earth

$M_E = 6 \times 10^{24} \text{ kg}$ and radius $R_E = 6.4 \times 10^6 \text{ m}$, we calculate $L_{rot}^{Earth} = 6.6 \times 10^{34} \text{ J s}$ that is 2.3 times larger than the Moon's orbital momentum $L_{orb}^{Moon} = 2.9 \times 10^{34} \text{ J s}$ (see **Table 1**).

Let us look at the structure of the Earth. According to the standard model it has:

- An inner core and an outer core that extend from the center to about 45% of the Earth radius with density $\rho_{max} = 13 \times 10^3 \text{ kg/m}^3$ and $\rho_{min} = 9.9 \times 10^3 \text{ kg/m}^3$;
- Lower mantle, spanning from the outer core to about 90% of the Earth radius (below 660 km) with density $\rho_{max} = 5.6 \times 10^3 \text{ kg/m}^3$ and $\rho_{min} = 4.4 \times 10^3 \text{ kg/m}^3$;
- Inner core, outer core, and lower mantle contain practically all of the Earth's mass [Dziewonski, A. M., Anderson, D. L. (1981)].

Very little is known about the lower mantle apart from that it appears to be a relatively seismically homogeneous. Outer core-lower mantle boundary has sharp drop of density $(9.9 \rightarrow 5.6) \times 10^3 \text{ kg/m}^3$ [Dziewonski, A. M., Anderson, D. L. (1981)]. In our opinion, lower mantle is a part of the Earth's core. It could be significantly different 4.57 Byr ago, since during this time it was gradually filled with all chemical elements produced by Earth's core due to UCF1 (1.3 TeV) self-annihilation. Considering the Earth's core with radius $R_{core}^{Earth} = 5.7 \times 10^6 \text{ m}$, the rotational angular momentum equals to:

$$L_{rot}^{Earth} = 6.5 \times 10^{34} \text{ J s}$$

which is 2.2 times larger than the orbital momentum of the Moon.

As for the Pluto–Charon pair, it is definitely a binary system. Charon was not generated by Pluto's core; instead, they are two objects that happened to be bounded together by gravity.

Mysteries of Solar System

According to E. Stone (Editor In Chief at *Little Astronomy*, 2022), these Mysteries are:

- **Why does Venus spin backwards?**

All the planets in SS rotate in the same direction except one: Venus. If you could look at all the planets from a point at the top of the North Pole, you would see all of them rotating counter-clockwise. But not

Venus that is spinning clockwise. Astronomers have two theories to explain why that happens. One of them is Venus could have suffered a huge impact with another object. That collision would have been so powerful it changed the direction of Venus rotational movement. The second theory is Venus is so close to the Sun and its atmosphere is so dense, the gravitational pull from the Sun created tides that flipped the planet's axis 180°.

- **Why is Uranus tilted sideways?**

Something very curious happens with Uranus rotation. It seems like the planet is on its side if you compare it to the other planets in the Solar System. While the rotational axis of the other planets is mostly perpendicular to the direction of the Sun, Uranus' axis is tilted and almost pointing to the star, making the planet look like it is rotating on its side. It is possible at some point in its history a huge object impacted Uranus and changed the direction of its axis. Some theories suggest that very same impact created most or all of its 27 moons (unbelievable!).

WUM. In our view , explanations of SS Mysteries (Venus spin backwards; Uranus tilted sideways; Moon creation; Mars hit by a giant cosmic lightning bolt; Planets difference in composition) based on the Impact theory are unrealistic and were proposed from hopelessness in frames of a Standard model. To the best of our knowledge, in literature it was never discussed and explained a real picture of planets angular momenta (see **Figure 1** and **Table 2**). Why do the Sun and all planets have different orientations of their motion being created from the same nebula with a **certain amount of angular momentum** (where it came from?).

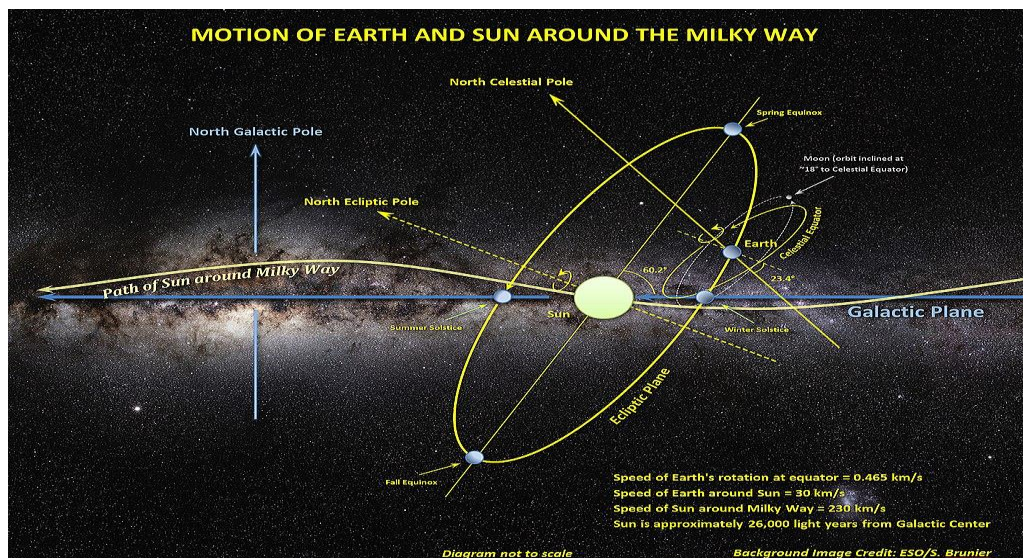


Figure 1. Orientation of the motion of SS Objects. Adapted from Wikipedia.

Table 2. Angular momentum of gravitationally rounded objects of SS. Adapted from Wikipedia.

Object	Value	Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
<u>Inclination</u>	<u>deg.</u>		7.00	3.39	0	1.85	1.31	2.48	0.76	1.77
<u>Axial tilt</u>	<u>deg.</u>	7.25	0.0	177.3	23.44	25.19	3.12	26.73	97.86	28.32

In astronomy, **axial tilt** is the angle between an object's rotational axis and its orbital axis, which is the line perpendicular to its orbital plane; equivalently, it is the angle between its equatorial plane and orbital plane. It differs from **orbital inclination** that is the tilt of an object's orbit around a celestial body. It is expressed as the angle between a reference plane and the orbital plane or axis of direction of the orbiting

object. The **ecliptic** or ecliptic plane is the **orbital plane of Earth around the Sun**. The **galactic plane** is the plane on which the majority of a disk-shaped galaxy's mass lies. The directions perpendicular to the galactic plane point to the galactic poles.

To be consistent with the Law of Conservation of Angular Momentum, we developed WUM, in which big angle between Galactic Pole and Ecliptic Pole is due to the random Volcanic Rotational Fission (VRF) of Milky Way UCM Core of many Extrasolar Systems UCM cores at the same time, so that the direction of the sum of all Extrasolar Systems angular momentum coincides with the direction of galactic poles. The same explanation is valid for the Sun's UCM Core and UCM cores of the planets with moons considering that they were created at the same time 4.57 billion years ago.

- **Why is the Sun's atmosphere hotter than its surface?**

One of the bigger and most counterintuitive mysteries of the Solar System for which we haven't been able to find answers is why is the outer layer of the Sun's atmosphere hotter than the surface of the star. The Sun is composed of multiple layers. The visible surface or the part we can see is called the photosphere and burns at a temperature of about 5,700 K. On top of that, the Sun also has an atmosphere and the outermost part of it is called the corona. One would think that being separated from the surface, the heat would start to dissipate, and the temperature of the corona would be lower than on the surface. Well, that's not the case. In fact, it is the extreme opposite as the temperature in the corona can reach 10^6 K. Some theories have been formed as to why this happens that have to do with the ionization of Helium in the atmosphere, but we don't know for sure.

WUM. Solar Corona is an aura of plasma that surrounds the Sun and extends at least 8×10^6 km into outer space (Sun's radius 7×10^5 km). Spectroscopy measurements indicate strong ionization and plasma temperature $\geq 10^6$ K. Corona emits radiation mainly in X-rays, observable only from outer space. Plasma is transparent to its own radiation and to solar radiation passing through it.

Coronal Heating problem in solar physics relates to the question of why the temperature of the Solar corona is millions of degrees higher than that of the photosphere. The high temperatures require energy to be carried from the solar interior to the corona by non-thermal processes. In our opinion, the origin of the Solar corona plasma is not coronal heating. Plasma particles (electrons, protons, multi-charged ions) are so far apart that plasma temperature in the usual sense is not very meaningful. Plasma particles are the result of self-annihilation of UC Particles. In WUM, Solar corona made up of UC Particles resembles a honeycomb filled with plasma particles. Geocorona and Planetary Coronas possess features like those of Solar Corona.

The following experimental results speak in favor of this model:

- Corona emits radiation mainly in X-rays due to self-annihilation of UC Fermions UCF3 (3.7 keV);
- The elemental composition of the Solar corona and the Solar photosphere are known to differ;
- During the impulsive stage of Solar flares, hard x-rays and gamma rays with energy above 100 GeV are emitted (one gamma quant had an energy as high as 467.7 GeV). In our view, it is the result of enormous density fluctuations of particles UCF1 (1.3 TeV) in the Solar corona and their self-annihilation. These fluctuations (named Coronal mass ejections) originate from the random volcanic activity of the Sun's UCM Core. Most powerful Solar flares have Coronal mass ejections.

- **How many unknown dwarf planets are out there?**

Our telescopes have been getting better really fast in the last few decades. With all these advancements, we started to find a lot of objects in SS we did not know about. This led to the creation of the Dwarf Planet category to label all these objects that did not really meet the criteria to be called a planet but were pretty close. The International Astronomical Union has officially recognized 5 dwarf planets so far;

including Pluto, but there are at least 30 other objects that have been proposed by multiple astronomers and that will be studied further in the coming years to see if they meet the criteria. Most of these dwarf planets would be located in the area known as the Kuiper belt, beyond the orbit of Neptune. Some astronomers believe there might be up to 200 dwarf planets out there waiting to be found.

WUM. From physical point of view, all gravitationally-rounded objects in SS, from Mimas, a small moon of Saturn ($R_M = 198 \text{ km}$, $M_M = 3.75 \times 10^{19} \text{ kg}$) to the Sun itself ($R_S = 7 \times 10^5 \text{ km}$, $M_S = 2 \times 10^{30} \text{ kg}$) are Macroobjects (MOs) with UCM cores inside of them that are UCM Reactors. It includes stars, planets, dwarf planets, and moons that are bigger than Mimas. Considering the total mass of the Kuiper belt $\sim 2 \times 10^{-2} M_{Earth}$ we can evaluate a number of MOs: $N_{MO} \lesssim 10^3$. So, there might be up to 200 dwarf planets in the Kuiper belt.

- **Does the Oort Cloud exist?**

Have you ever wondered where do comets come from? To solve that question, astronomers have theorized that a group of millions and maybe billions of small, icy, rocky objects exists on the outer limits of the Solar System. These objects form a huge “cloud” named the Oort Cloud after one of the astronomers who proposed it. Sometimes these objects will change be shot out of the Oort Cloud due to collisions or gravitational forces and become wandering comets. The objects in the Oort Cloud are too small and far away to reflect any light from the Sun so their existence is still not confirmed.

WUM. In our opinion, observations of short-period ecliptic comets and long-period isotropic comets are experimental confirmation of the Oort Cloud existence. In WUM, Ecliptic comets were produced by the Sun itself as the result of VRF of the Sun’s UCM Core. Nearly isotropic comets were produced by Giant Planets, which are, in fact, “Failed stars” with different directions of rotational axis as the result of VRF of their UCM cores (see **Table 1**). **Oort Cloud belongs to Solar System!**

- **How was the Moon created?**

One of the things that says a lot about how little we still know about our universe is the fact we don’t even know for sure how our own Moon was formed. The current theory most astronomers agree on is that at some point early in the Solar System’s life, a planet around the size of Mars crashed against Earth. This collision left a lot of debris and pieces of both planets hanging around but still trapped by Earth’s gravity and were left orbiting it. After millions of years, all these pieces came together thanks to gravity and formed the Moon. While the theory is widely accepted, it leaves some questions up in the air; like why wasn’t Earth taken out of its orbit by this impact? and what happened to the other hypothetical planet?

WUM. The Moon is a differentiated body, being composed of geochemically distinct crust, mantle, and planetary core. Moonquakes have been found to occur deep within the mantle of the Moon about 1,000 km below the surface. The size of the lunar core is only about 20% the size of the Moon itself, in contrast to about 50% as is the case for most other terrestrial bodies. In February 2022, astronomers used NASA’s SOFIA telescope to scan an immense region near the south pole of the Moon and revealed an abundance of water trapped on the shady sides of mountains and in the shadowed parts of craters [Reach W. T., *et al.* (2023)].

In WUM, the internal structure of the Moon can be explained the same way as it was done for the Earth and Mars. It is worth noting that the UCM core of the Moon is much less than UCM core of the Earth. This result is in good agreement with the proposed by WUM mechanism of the Moon creation: UCM Core of the Moon was born as the result of VRF of the Earth UCM Core 4.57 billion years ago.

- **Did Mars have oceans in the past?**

For years astronomers have found evidence of erosion, channels, and canyons on Mars. As far as we know, all of those are caused by liquid water slowly forming them. From that data, we can hypothesize that at

some point in the past Mars has liquid water running on the planet. Some astronomers think even one-third of the Martian surface could have been covered in water. Some scientists believe even today it would be possible for water to exist under Mars' surface where it is safe from many of the effects that would have caused the surface water to disappear. The more we explore and study Mars, the more this theory seems correct, but that opens other questions. What happened to Mars that made all that water evaporate or freeze? Could there have been life on the red planet at some point?

WUM. The proposed concept of **UCM Reactors** in Cores of all gravitationally-rounded MOs successfully explains all contemporary hypothesis and results for the Early Earth:

- In the paper “*Uncovering Mysteries of Earth’s Primeval Atmosphere 4.5 Billion Years Ago and the Emergence of Life*” (2020) ETH Zurich (a leading scientist P. Sossi) wrote: *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 WUM, Upper mantle with Crust are due to the UCM core volcanic activity of the “homemade” compositions (including magma), which produced as the result of the self-annihilation of UC Particles in the UCM core. It explains the result that continental crust had formed by 4.4-4.5 Byr.

- According to “Lumen Learning, Earth Science” (2021): *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.* In WUM, Earth's Atmosphere and Oceans were formed by the volcanic activity and outgassing of UCM core. In our opinion, analogous processes happened on early Mars too. But because of much less size of the UCM core and mass of Mars ($R_{Mars}^{core} = 1.83 \times 10^3 \text{ km}$; $M_{Mars} = 6.42 \times 10^{23} \text{ kg}$) in comparison with the Earth ($R_{Earth}^{core} = 3.52 \times 10^3 \text{ km}$; $M_{Earth} = 5.97 \times 10^{24} \text{ kg}$), the rate of creation of Mars’s Atmosphere and Oceans and the forces of gravity preventing the water from leaving the planet are much less than it is for the Earth. So, water evaporated from the surface of Mars. We believe that there is underground water on Mars.

- **Was Mars hit by a giant cosmic lightning bolt?**

There is a huge, strange canyon on Mars called Valles Marineris. Just to give you an idea of how big it is, it is about 4 times deeper and 5 times longer than the Grand Canyon in Arizona. But its weirdness only starts there. Some scientists believe this canyon wasn’t formed in a traditional way (water slowly eroding the land over the course of millions of years) but in a much cooler manner. They believe Valles Marineris is a scar. For years scientists have theorized the existence of cosmic lightning bolts. Imagine a lightning bolt, but on a cosmic scale, traveling across the cosmos with unimaginable amounts of energy. Then imagine this bolt hits a planet, let’s say, Mars. The impact would be big enough to leave a mark forever on the planet and create a valley the size of Valles Marineris. One more piece of evidence that could support the lightning bolt theory is that Mars also has a hole in its atmosphere that is leaking hydrogen into space. Could this hole have been created by that very same impact? Is that the reason Mars lost its ocean?

WUM. In our view, a giant cosmic lightning bolt and *Valles Marineris* is a scar on the Mars surface are unimaginable. Some of the most notable surface features on Mars include *Olympus Mons*, the largest volcano and highest-known mountain in SS, and *Valles Marineris*, one of the largest canyons in SS. Mars is seismically

active. In 2019, it was reported that InSight had detected and recorded over 450 marsquakes and related events. In 2021 it was reported that the core of Mars was indeed liquid and had a radius of about 1830 ± 40 km and a temperature around 1900–2000 K. In WUM, the Martian core is a liquid UCM core with very high viscosity that functions as solid-state object. It is a UCM Reactor that provides enough energy for volcanic and plate-tectonic activities. As the result, there were created *Olympus Mons* and *Valles Marineris*.

- **Why are the planets so different in composition?**

Most astronomers agree on the origin of SS. They believed a disk of rocks and pebbles formed around the Sun and they started fusing impacting one another and fusing together to form the planets. But this creates a problem. If all the planets formed from the same disk and grew together at the same time, how come they ended up being so different from one another? Some of the differences between planets can be attributed to variables like how close they are to the Sun. This explains for example why some planets could hold liquid water like Earth and (maybe) Mars while others can't because they are too cold, but it doesn't explain other things like the vast differences in size and composition. Some theories suggest solar winds "blew away" the lighter materials, allowing for the outer planets to have a different composition. Another study found a correlation between the calcium isotope and the size of the planets, suggesting planets grew at the same rate, but then stopped growing at different times.

WUM. According to the developed model of MOs, all chemical elements, compositions, rocks are produced by MOs themselves as the result of UC Particles self-annihilation. The diversity of all gravitationally-rounded objects of SS is explained by their distance from the Sun, and the differences in their UCM Cores (mass, size, composition). UCM Reactors inside of them in hydrostatic equilibrium provide sufficient energy for all geological processes on planets and satellites.

- **Do Jupiter and Saturn even have a core?**

When we have lived only on one planet, it is hard to imagine how a different one might be so different and weird and in the case of Jupiter, Saturn, and others, so not-solid. While these two giants of our Solar System look just like a planet, they are mostly just gas as far as we can tell. If you were to take a guess without knowing, it would be easy to think behind all those storms, clouds and gas we see on top of those planets there would be a surface we might be able to land on some day and explore. Well, there isn't. If you were to drop something on Jupiter, it wouldn't hit the surface. It would just drop down into the center of the planet until it was crushed by the pressure. Scientists believe both planets might have a core with a thin, rocky or icy layer in the middle because it fits with our current model for how planets are formed. The problem is, we have never actually seen or confirmed such core exists and data found by the Juno spacecraft on Jupiter left us with more questions than answers as it suggests Jupiter's core might be dissolved.

WUM. All planets (including Jupiter and Saturn) have UC Matter cores.

- **Why does Pluto have mountains?**

The dwarf planet Pluto has some of the most unique features of any other object in SS. It has huge mountains made almost entirely out of ice. The question that puzzles scientists is where did they come from? For a mountain to be created there needs to be geological activity. That means tectonic plates moving because of volcanic activity or some other form of heat release. And that's where the big mystery lies, where are the heat and energy coming from?. As far as we can tell, Pluto is too far away from the Sun to receive much energy from it and its core is just ice and rock so there's no lava flowing. One theory suggests Pluto might have some sort of system of cryovolcanoes, which are basically volcanoes that spit water or gases, but the reality still remains a question to be answered.

WUM. Pluto have mountains due to the volcanic activity of UCM Reactor inside of it.

- **How big is the Solar System really?**

*As we mentioned above when we talked about the Oort Cloud, we still don't know much about the outer edges of the Solar System. So much we don't even know where it ends. Some astronomers mark the end of SS at the **Heliopause**, the imaginary line where the solar winds stop. That would make SS about 79 AU wide in diameter, but the Oort cloud would be located way beyond that. If we take the Oort Cloud as the line for the SS's end, it is estimated it could be up to 200,000 AU away or a little more than 3 light years.*

WUM. According to WUM, the radius of SS is about 96,335 AU that is in good agreement with the size of the **spherical outer Oort Cloud** 100,000 AU. It was created as a result of VRF of the overspinning UCM Cores of Giant planets (Jupiter, Saturn, Uranus, and Neptune), which are, in fact, "Failed stars", and have significantly different **Inclinations** and **Axial tilts** (see **Table 2**). All **long-period nearly isotropic comets** have very large orbits and appear from every direction in the sky.

E. Stone made the following conclusion:

As you can tell from our list, there are still many questions about our SS that need to be answered. We only picked the most interesting ones for this list but there are many more that didn't make the cut like the crater shaped like a spider in Mercury or why is Titan the only moon with an atmosphere. With all the advances in equipment and new techniques we will hopefully get some answers to a lot of these questions in the coming decades so stay tuned and keep learning. Maybe you will be the one who figures them out.

Explained Problems of Solar System

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

- **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 particles is not coronal heating. Plasma particles (electrons, protons, multi-charged 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 UC Particles. The Solar corona made up of UC Particles 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 UC Particles by Cores. UC Particles 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 UCM Reactors inside of all MOs fueled by UC Particles. Internal Heating is due to UC Particles self-annihilation;
- **Diversity of Gravitationally-Rounded Objects** in SS is explained by UCM Reactors inside of MOs fueled by UC Particles. All chemical elements, compositions, radiations are produced by MOs themselves as the result of UC Particles self-annihilation in their different UCM 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 UCF1 (1.3 TeV) 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 UCM core absorbs new UC Particles, and its size is increasing in time $\propto \tau^{1/2}$. Hence, there is an expansion of UCM core, and its surface (the Upper mantle with Crust) is likewise expanding. Due to UC Particles 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 cores absorb new UC Particles, 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 age of SS $\cong 4.6$ Byr, it is easy to find that a young Sun's output was only 67.6% of what it is today;
- **Solar Corona, Geocorona and Planetary Coronas** made up of UC Particles resemble honeycombs filled with plasma particles (electrons, protons, multi-charged ions), which are the result of UC Particles self-annihilation.

Conclusion

The World consists of two different kind of Matter: UCM (92.8%) with self-annihilating UC particles and Ordinary Matter (7.2%) that is, in fact, Electromagnetic Matter with particles: protons, electrons, photons, and neutrinos. They have different origin of radiations:

- Electromagnetic waves from Radio waves up to X-rays are emitted by electrons outside nuclei;
- Gamma rays are emitted by nuclei, as it is the case for self-annihilating UC particles. Majorana fermions, long-theorized particles that are their own antiparticles, were hypothesized by Ettore Majorana in 1937. Scientists have yet to detect these self-annihilating particles inside particle accelerators. In our opinion, proposed by WUM UC Particles confirm this prediction.

It is worth noting that in the same year, P. Dirac foresaw the Future of Physics in New Cosmology. Considering JWST discoveries, successes of WUM, and 87 years of Dirac's proposals, it is high time to make a Paradigm Shift for Cosmology and Classical Physics.

Astronomers have great achievements in investigations of the Solar System that became an Experimental laboratory for Astrophysicists to check their theories. We are at the Beginning of a New Era of Astronomy, Cosmology, and Astrophysics! Young physicists should be a part of It. They should concentrate their efforts on the development of a New Cosmology and Classical Physics. I am very excited about the Future of Physics!

Acknowledgements

I am always grateful to Academician Alexander Prokhorov and Prof. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father P. Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to N. Tesla who was a genius. I am much obliged to Prof. C. Corda for publishing my [manuscripts](#) in the Journal of High Energy Physics, Gravitation and Cosmology. I am grateful to N. Percival and H. Ricker for valuable comments and suggestions, which have led to an overall improvement of the Presentation. Special thanks to my son I. Netchitailo who helped me clarify Model and improve its understanding.

Presentation 6. Earth [22][37][39]

Universe-Created Matter

In my four previous Presentations, I followed the standard paradigm "**Dark Matter**" that is not quite right for Hypersphere World-Universe Model (WUM), in which the World consists of particles of Ordinary Matter: protons, electrons, photons, and neutrinos. On the other hand, there are particles created by the Universe – Universe-Created (UC) Particles of a new kind of "**Universe- Created Matter**" (UCM). In the fifth Presentation, I introduced a new term – UC Particles, which have following characteristics: **UC Fermions** or **Bosons, Rest Energies** (see **Table 1**), **Weak Interaction**, and **Self-annihilation**, like Majorana fermions. Ordinary particles are a byproduct of UC Particles self-annihilation. It is easy to switch from Dark (**D**) Matter to Universe-Created (**UC**) Matter.

Table1. Universe-Created Particles.

Fermion			Boson		
Particle	Rest Energy	Value	Particle	Rest Energy	Value
UCF1	$\alpha^{-2}E_0$	1.3149948 <i>TeV</i>	DIRAC	α^0E_0	70.025252 <i>MeV</i>
UCF2	$\alpha^{-1}E_0$	9.5959804 <i>GeV</i>	ELOP	$2/3\alpha^1E_0$	340.66596 <i>keV</i>
UCF3	α^2E_0	3.7289394 <i>keV</i>	XION	$1/2\alpha^6E_0$	5.2870895 μeV
UCF4	α^4E_0	0.19857107 <i>eV</i>			

In this Table, a Basic Energy Unit E_0 equals to:

$$E_0 = hc/a = 70.025252 \text{ MeV}$$

h is the Planck constant, c is a Gravitodynamic constant, a is a basic size unit:

$$a = 1.7705641 \times 10^{-14} \text{ m}$$

and α is a dimensionless Rydberg constant.

These particles are "dark", **optically invisible**, when astronomers observe the World with telescopes only. The contemporary Astronomy allows us to observe the World in wavelengths from radio waves up to gamma rays! Then, they are not "dark" at all. The first known binary system was Cygnus X-1(1971) that is typically the brightest persistent source of **hard X-rays with energies up to 60 keV**. In 2000, R. Minchin, *et al.* discovered binary galaxy system VIRGOHI 21 with NGC 4254, which has the **21-cm emission**.

This two kind of Matter have different origin of radiations:

- Ordinary Matter radiates Electromagnetic waves from Radio waves up to X-rays by electrons outside nuclei. Lawrence Livermore scientists probed nitrogen gas at X-ray energies of up to **8 keV, the highest X-ray energy** ever used at an X-ray free electron laser.
- UC Matter radiates **Gamma rays**, which emitted by nuclei, as a result of self-annihilation of UC Particles (UCPs) with rest energies, covering eighteen orders of magnitude (see **Table 1**).

Introduction

Every year on April 22, 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 [ESA (2023)]. 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.

In this Presentation, we give a short overview of the developed WUM and pay particular attention to the principal role of UCM in the Earth's life. Below, 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 "Geomagma" (with electrical conductivity); 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. The Model revealed the fact that the Sun and the Moon activity causes the Geomagma activity and, as a consequence, Random Variations of Earth's Rotational Speed by the periodically varying Sun's and Moon's magnetic field.

Essence of WUM

Principal Points of WUM are as follows:

- The Finite World is a 3D Hypersphere of the 4D Nucleus of the World, which is 4D bubble 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 UCM in the 4D Nucleus of the World. UCPs carry new UCM into the World. Luminous Matter is a byproduct of UCPs self-annihilation. UCM plays a central role in creation and evolution of all Macroobjects (MOs);
- WUM introduces Dark (invisible) Epoch (spanning from 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 $A_\tau = 14.22 \text{ Byr}$ is determined by the experimentally measured value of Gravitational parameter G . Transition from Dark Epoch to Luminous Epoch is due to an Explosive Volcanic Rotational Fission of Overspinning UCM Supercluster Cores and self-annihilation of UCPs;
- WUM is the only cosmological model in existence that is consistent with the Fundamental Law of Conservation of Angular Momentum;
- The Medium of the World, consisting of protons, electrons, photons, neutrinos, and UCPs, 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;
- MOs of the World possess the following properties: their Cores are made up of UCPs; they contain other particles, including UCPs and Ordinary particles, in shells surrounding Cores. MOs cores are essentially UCM Reactors fueled by UCPs. All chemical elements, compositions, substances, rocks, *etc.* are produced by MOs themselves as the result of UCPs self-annihilation in their Cores;
- 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.

Early Earth

Formation of Earth. The oldest material found in Solar System (SS) is dated to 4.568 Byr [Bouvier, A., Wadhwa, M. (2010)] that is almost equal to 4.57 Byr. In the article "*The age of the Earth in the twentieth century: a problem (mostly) solved*" G. B. Dalrymple (2001) 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.*

In **WUM**, UCM core of the Earth was born as the result of the Explosive Volcanic Rotational Fission of the Sun's UCM Core 4.57 Byr ago.

Origin of Moon. 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.

Establishing the age of the Moon is critical to understanding SS evolution and the formation of rocky planets, including Earth. In 2023, J. Greer, *et al.* in the article “*4.46 Ga zircons anchor chronology of lunar magma ocean*” have dated the Moon to at least 4.46 Byr old. We stress that 110 Myr is not enough for the formation of Moon in accordance with giant-impact hypothesis.

In **WUM**, UCM core of the Moon was born as the result of the Explosive Volcanic Rotational Fission of the Earth’s UCM Core 4.57 Byr ago.

Continental Crust of Earth. The long-favored paradigm for the development of continental crust is one of progressive growth beginning at about 4 Byr ago. To test this hypothesis, T. M. Harrison, *et al.* (2005) measured initial $^{176}\text{Hf}/^{177}\text{Hf}$ values of 4.01 – 4.37 Byr detrital zircons from Western Australia. They obtained results that support the view that crust had formed by 4.4 – 4.5 Byr ago and was rapidly recycled into the mantle (compare with the age of the Moon at least 4.46 Byr old).

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*” (2021): *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.*

In the article “*Uncovering Mysteries of Earth’s Primeval Atmosphere 4.5 Billion Years Ago and Emergence of Life*”, a leading scientist P. Sossi wrote (2020): *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 article “*Redox state of Earth’s magma ocean and its Venus-like early atmosphere*”, P. A. Sossi, *et al.* (2020) 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 the 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.* (2017) in the article “*Evidence for early life in Earth’s oldest hydrothermal vent precipitates*” wrote: *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 3.77 billion and possibly 4.28 billion years old in ferruginous sedimentary rocks, interpreted as **seafloor-hydrothermal vent-related precipitates**. Collectively, these observations are consistent with an oxidized biomass and provide evidence for biological activity in submarine-hydrothermal environments more than 3.77 billion years ago.*

WUM. The proposed concept of **UCM Reactors** in UCM Cores of all gravitationally-rounded MOs successfully explains all these hypothesis and results for the Early Earth:

- The Upper mantle with Crust are due to the UCM core volcanic eruptions of the “homemade” compositions (including magma), which produced as the result of the self-annihilation of UCPs in the

core. It explains the result that continental crust had formed by 4.4 – 4.5 Byr ago;

- Earth's Atmosphere and Oceans were formed by a volcanic activity and outgassing of UCM 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 3.77 billion years ago* can be explained by a generation of all kinds of chemical elements and compositions produced into the Earth's UCM core.

Modern Earth

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.

Main characteristics of the Earth's layers are presented in **Table 2**.

Table 2. Density and Mass of Earth's Layers. Adapted from article by Robertson, E. C. (2001)

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 $\rho_{max} = 13.1 \times 10^3 kg/m^3$ 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 $\rho_{min} = 3.4 \times 10^3 kg/m^3$;
- There is a seismicity cutoff-660 (660-km discontinuity): $\rho_{min} = 3.4 \times 10^3 kg/m^3$ for Lower mantle is less than $\rho_{max} = 4.4 \times 10^3 kg/m^3$ for Upper mantle;
- The Earth core is rotating faster than its surface by about 0.3-0.5 degrees per year;
- Inner core, Outer core, and Lower mantle contain most of the Earth's mass.

In our view, the Inner core, Outer core, and Lower mantle are the parts of the Earth's liquid UCM 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.

It is worth noting that Solar Core rotates 3.8 ± 0.1 faster than the surrounding envelope. The fact that the Earth core and Solar Core rotate faster than surrounding envelope, despite high viscosity of the internal medium, is intriguing. WUM explains this phenomenon through the absorption of UCPs by Earth core and Solar Core over time τ . UCPs supply not only additional mass ($\propto \tau^{3/2}$), but also additional angular momentum ($\propto \tau^2$). UCM Core irradiates products of UCPs self-annihilation, which carry away excessive angular momentum. The Solar Wind is the result of this mechanism.

The 660-km Boundary. Geomagma. W. Wu, S. Ni, and J. Irving (2019) investigated scattered seismic waves traveling inside the Earth to constrain the roughness of the Earth's 660-km boundary. The researchers were surprised by *just how rough that boundary is – rougher than the surface layer that we all live on. Their statistical model did not allow for precise height determinations, but there is 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* [Princeton University (2019)]. Lacking a formal name for this layer, the researchers simply call it "*the 660-km boundary*."

X. Markenscoff (2021) in the article "*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*".

According to **WUM**, the 660-km boundary is a boundary between Earth's UCM core and Upper mantle with Crust, which were produced by UCM core during 4.57 Byr. The deep-focus earthquakes are connected with random mass ejections happening at the 660-km boundary as the result of UCPs self-annihilation in the UCM core. All chemical elements, compositions, substances of the Earth including protons, electrons, multi-charged ions, isotopes K-40, U-238, Th-232, Pu-244 are produced within UCM Reactor inside of the Earth as the result of UCPs self-annihilation. They concentrate into "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 [Ricard, Y. (2009)].

Earth Magnetic Field

According to Wikipedia, the magnetic north pole is a point on the surface of Earth's Northern Hemisphere at which the planet's magnetic field points vertically downward. There is only one location where this occurs, near (but distinct from) the geographic north pole. The geomagnetic north pole is the northern antipodal pole of an ideal dipole model of the Earth's magnetic field. North magnetic pole moves over time. In 2001, it was determined lie west of Ellesmere Island in northern Canada. In 2009, it was moving toward Russia at between 55 and 60 km per year. In 2013, the distance between the north magnetic pole and the geographic north pole was approximately 800 km. Its southern hemisphere counterpart is the south magnetic pole. Since Earth's magnetic field is not exactly symmetric, the north and south magnetic poles are not antipodal, meaning that a straight line drawn from one to the other does not pass through the geometric center of Earth.

In 1822, A.-M. Ampère proposed that internal currents are responsible for Earth magnetism. In 1919, J. Larmor proposed that a dynamo might be generating the field. W. M. Elsasser considered a "father" of the presently accepted dynamo theory as an explanation of the Earth's magnetism. During 1946–47, Elsasser published papers describing the first mathematical model for the origin of the Earth's magnetic field. He conjectured that it could be generated by electric currents in the conductive iron alloys of its core, created by

convection currents due to **heat escaping from the core**. The Earth and most of the planets in SS, as well as the Sun and other stars, all generate magnetic fields through the motion of **electrically conducting fluids**.

At dawn of the 21st century, numerical modeling of the Earth's magnetic field has not been successfully demonstrated. Initial models are focused on field generation by convection in the planet's fluid outer core. It was possible to show the generation of a strong, Earth-like field when the model assumed a uniform core-surface temperature and exceptionally high viscosities for the core fluid. Computations which incorporated more realistic parameter values yielded magnetic fields that were less Earth-like but indicated that model refinements may ultimately lead to an accurate analytic model. Slight variations in the core-surface temperature, in the range of a few mK, result in significant increases in convective flow and produce more realistic magnetic fields.

The Moon has an external magnetic field of less than about 10^{-5} that of Earth. Contemporary view is that the Moon does not have a global dipolar magnetic field and only has crustal magnetization likely acquired early in its history when a dynamo was still operating. Early in its history, 4 Byr ago, its magnetic field strength was likely close to that of Earth today. This early dynamo field apparently expired by about one Byr ago, after the lunar core had crystallized.

Sun's magnetic field explained the following way: the radiative zone and 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, or solar dynamo, within this layer generates the Sun's magnetic field.

It is worth noting that Solar Core rotates 3.8 ± 0.1 faster than the envelope and the Earth core is rotating faster than its surface by about 0.3-0.5 degrees per year, which can explain the large shear.

According to **WUM**, all gravitationally rounded MOs have the same internal structure: UCM core, different envelope and intermediate layers between them, electrical currents of which define their magnetic fields. In case of Milky Way Galaxy, it is electron-positron shell, Sun – the tachocline, Earth – the 660-km boundary that we named “Geomagma”, Moon – a boundary between core and mantle that we named “Lunarmagma”.

Random Variations of Earth's Rotational Speed

G. Jones and K. Bikos in the 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 $86,400^{+1.62ms}_{-1.46ms}$ 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**, **Figure 3**, and **Figure 4**).

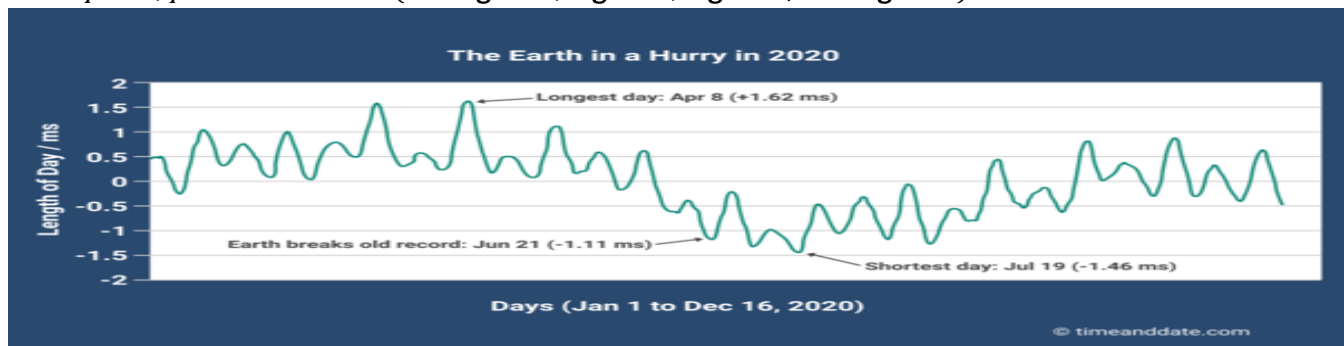


Figure 1. Variation of daylength throughout 2020. The length of day is shown as the difference in ms.

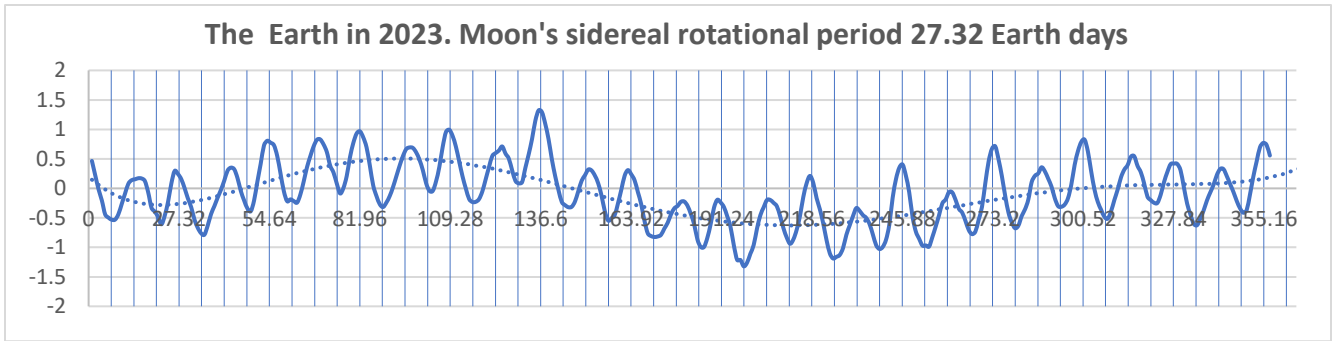


Figure 2. Variation of daylength throughout 2023.

It is worth noting that there is some kind of periodicity of peaks on **Figure 1**. We used the data obtained by G. Jones, *et al.*(2023), and got Variation of daylength throughout 2023, depicted on **Figure 2**. As a result, we found similar peaks with a periodicity 13.66 Earth days, which equals to the half of Moon's sidereal rotation period (fixed star to fixed star) 27.32 Earth days. It means that a “Lunarmagma”, electrical currents of which define the Moon’s magnetic field, influences Geomagma (with electrical conductivity) and, as a result, changes the Earth’s day length.

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 UCM Reactor (UCMR) and Geomagma. As the result of UCPs self-annihilation, **random mass ejections** are happening. During a time of high UCMR 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.

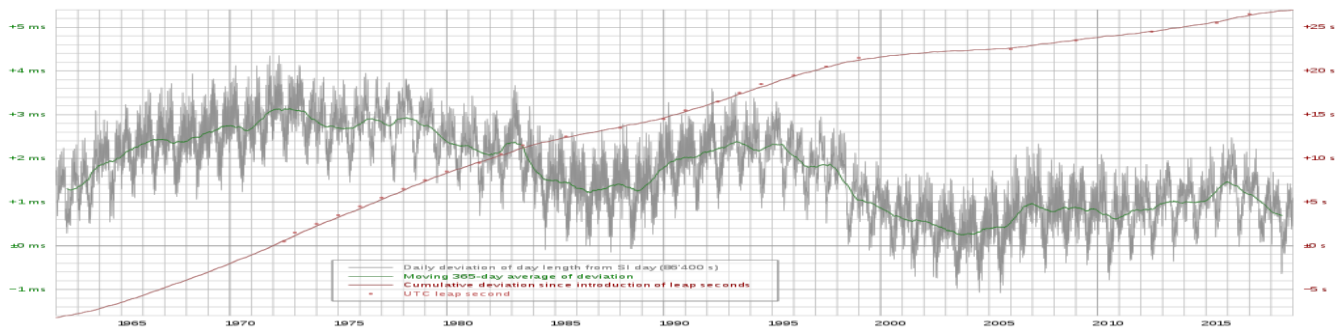


Figure 3. Deviation of daylength from SI based day since 1962 to 2019. Adapted from Wikipedia.

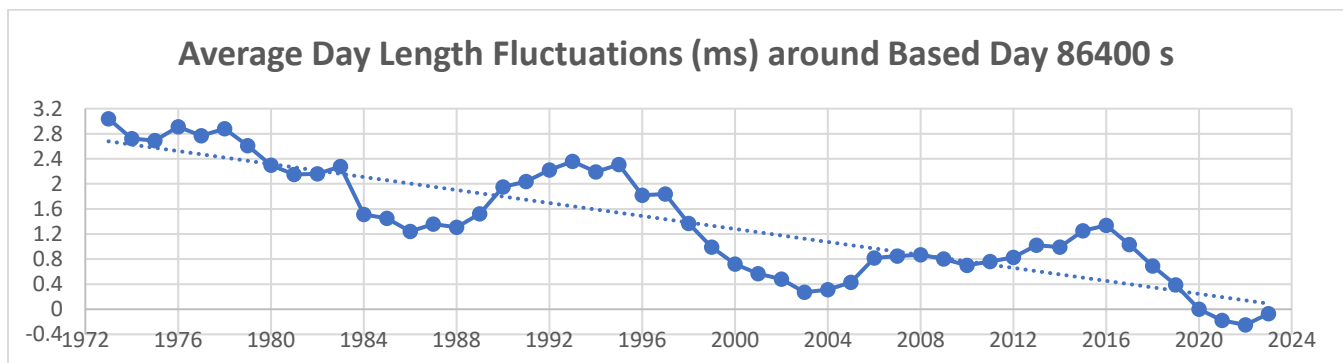


Figure 4. Deviation of average day length from SI based day since 1973 to 2023. Adapted from the article by Jones, G., Bikos, K., and Hocken V. (2023).

Let us analyze the proposed mechanism. The relative change of the daylength throughout 2020 and 2023 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 2**): $\frac{m}{M} \sim 10^{-6}$ and $\frac{h}{R} \sim 10^{-2}$. It means that $h \sim 64 \text{ km}$. In case of the Oceans: $\frac{m}{M} \sim 10^{-4}$ and $\frac{h}{R} \sim 10^{-4}$. It means that $h \sim 640 \text{ m}$. In case of the Geomagma: $\frac{m}{M} \sim 10^{-5}$ and $\frac{h}{R} \sim 10^{-3}$. It means that $h \sim 6.4 \text{ km}$.

The estimated values of the masses and shifts 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 ;
- They can be explained by random mass ejections in the Geomagma;
- It is worth noting that since 1973 to 2023 (see **Figure 4**), the averaged deviation of the average day length dropped down from 2.7 ms to 0.1 ms. We explain this drop the following way: UCPs supply additional angular momentum ($\propto \tau^2$). Relative additional Earth angular momentum for $\Delta t = 50 \text{ yr}$ 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 a day will be shorter by $2.2 \times 10^{-8} \times 86400 = 1.9 \text{ ms}$, which is in good agreement with experimentally observed 2.6 ms (see **Figure 4**).
- The maximum activity of UCMR and Geomagma and maximum of the average day lengths 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 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 (**Figure 5**). 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 Earth's average day length (see **Figure 4**). It means that the maximum Sun activity at 2016, 2006, 1995, 1983, and 1972 causes the maximum Geomagma activity and maximum of the average day lengths.

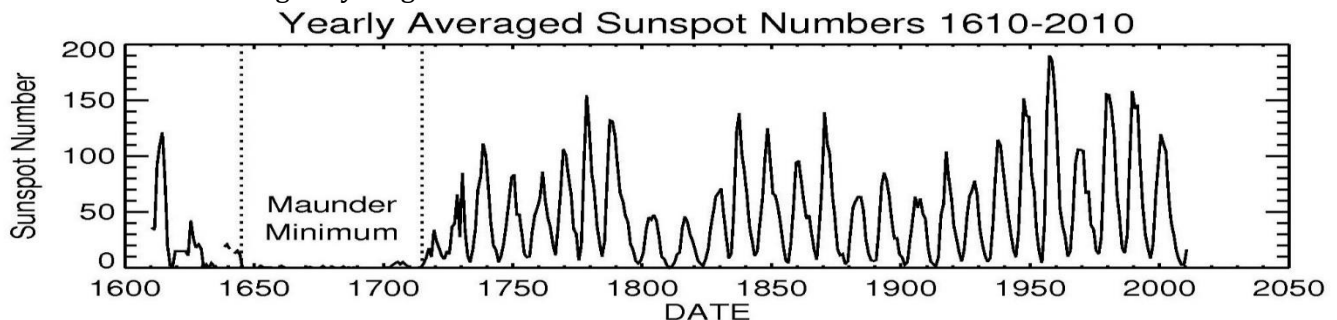


Figure 5. The yearly averaged sunspot number for a period of 400 years (1610-2010).

As the conclusion, we revealed Sun-Earth-Moon Interaction that is responsible for Large-scale (years) and Small-scale (days) variations of the Earth's daylength defined by the Sun and the Moon.

Mysteries of Earth Explained by WUM

Expanding Earth. This 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 recognition of plate tectonics, scientific consensus has rejected any significant expansion or contraction of Earth.

In **WUM**, the Earth's UCM core absorbs new UCPs, and its size is increasing in time $\propto \tau^{1/2}$. There is an expansion of UCM core, and hence, the Upper mantle with Crust is stretching out. Due to UCPs self-annihilation, new chemical elements are created inside of the Upper mantle with Crust. As a result, the relative movement of continents is happening.

Internal Heating. The analysis of the Sun's heat for planets in SS yields the effective temperature of the Earth of 255 K [Cole, G.H.A., *et al.* (2002)]. The actual mean surface temperature of Earth is 288 K [Kinver, M. (2009)]. 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 ± 1.0 TW [Pollack, H.N., *et al.* (1993)]. The Earth's Uranium has been thought to be produced in one or more supernovae over 6 Byr ago.

Radiogenic Decay. It 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 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 the conclusion that "*heat from radioactive decay contributes about half of Earth's total heat flux*" [Gando, A., *et al.* (2011)].

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's present existence in Nature.

In **WUM**, all chemical products of the Earth including isotopes K-40, U-238, Th-232, and Pu-244, are produced by UCMR inside of the Earth during 4.57 Byr and are, in fact, "Homemade". They are the result of UCF1 (1.3 TeV) self-annihilation (compared to the 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 [Ricard, Y. (2009)].

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

Faint Young Sun Paradox. It 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 a 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 C. Sagan and G. Mullen in 1972. An unresolved question is how a climate suitable for life was maintained on Earth over the long timescale despite the variable solar output. Proposed resolutions of this paradox have taken into account greenhouse effects, changes to planetary albedo, etc.

One of the consequences of **WUM** holds that all stars were fainter in the past. As their cores absorb new UCM, 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% [Gough, D. O. (1981)].

In frames of **WUM**, the Upper mantle with Crust are due to UCM core activity: a self-annihilation of UCPs in the UCM core. As the 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.

Geocorona and Planetary Coronas. The geocorona is the luminous part of the outermost region of the Earth's atmosphere, which extends to at least 640,000 km from the Earth [Baliukin, I.I., *et al.* (2019)]. It is seen primarily via far-ultraviolet light from 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. 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 [Kameda, S., *et al.* (2017)]. 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 [Kuwabara, M., *et al.* (2017)]. 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 . X-rays were observed in the range of energies 0.08 – 10 keV [Kameda, S., *et al.* (2017)]. 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 [NASA (2012)]. This process is called "charge exchange" since an electron is exchanged between neutral atoms in geocorona and ions in the solar wind.

X-rays from Planets were also observed by Chandra (2012). 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 our opinion, the described picture of Geo and Planetary Coronas is similar to the picture of a 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 UCF3 (3.7 keV) self-annihilation;

- 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.

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

- The Geocorona made up of UCPs 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 $R_{in} \cong 6,400 \text{ km}$ and observed outer radius $R_{out} \cong 640,000 \text{ km}$. The total mass of this Shell is $\cong 4.1 \times 10^{18} \text{ kg}$;
- 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 UCPs self-annihilation. They are going not only up and out of the Earth, but also down to the Earth's surface.

According to **WUM**, the characteristics of Geocorona are similar to the characteristics of the Solar Corona. As the result of a large fluctuation of UCPs 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, Terrestrial Gamma-Ray Flashes (TGFs) are, in fact, well-known Gamma Ray Bursts. The spectra of TGFs at very high energies can be explained by UCF1 (1.3 TeV) and UCF2 (9.6 GeV) self-annihilation. Lightning initiation problem can be solved by X-rays and gamma-rays, which slam into thunderclouds and carve a conductive path through thunderstorm. From this point of view, it is easy to explain all experimental results, which we will discuss in Presentation 7.

Conclusion

ALLATRA International Public Movement was founded in 2011 on 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.

We hope that WUM that 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 Planet. In our opinion, we should concentrate our efforts on investigations of the Oceans and Volcanoes, which are responsible for the climate changes.

Acknowledgments

I am always grateful to Academician A. Prokhorov and Prof. A. Manenkov, whose influence on my scientific life has been decisive. I am eternally grateful to my Scientific Father P. Dirac who was a genius and foresaw the Future of Physics in a New Cosmology. I am forever grateful to N. Tesla who was a genius. I am much obliged to Prof. C. Corda for publishing my [manuscripts](#) in the Journal of High Energy Physics, Gravitation and Cosmology. I am grateful to N. Percival and H. Ricker for valuable comments and suggestions, which have led to an overall improvement of the Presentation. Special thanks to my son I. Netchitailo who helped me clarify Model and improve its understanding.

Presentation 7. High-Energy Atmospheric Physics.

Ball Lightning. Tunguska Event [7][8][14]

Earth

In the previous Presentation 6, we discussed 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 “Geomagma” (with electrical conductivity); 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. Our Model revealed the fact that the Sun and the Moon activity causes the Geomagma activity and, as a consequence, Random Variations of Earth’s Rotational Speed by the periodically varying Sun’s and Moon’s magnetic field. Today, we will discuss Earth’s High-Energy Atmospheric Physics.

Introduction

In his “The mystery of Lightning” review (2012), leading lightning physicist J. R. Dwyer provides an excellent overview of the main experimental observations and leading models of thunderstorms and lightnings. Many mysteries remain about how thunderstorms and lightnings work, including how lightnings get started. It is established that thunderstorms and lightnings produce intense bursts of x-rays and gamma-rays. These high-energy radiations may be important for understanding how lightning works.

In this Presentation, we give an explanation for High-Energy Atmospheric phenomena through the frames of Hypersphere World – Universe Model (WUM). In WUM, Terrestrial Gamma-Ray Flashes (TGFs) are, in fact, Gamma-Ray Bursts. The spectra of TGFs at very high energies are explained by Universe-Created Particles (UCPs) self-annihilation in Geocorona. Lightning initiation problem is solved by Gamma-Ray Bursts, which slam into thunderclouds and carve a conductive path through a thunderstorm.

High-Energy Atmospheric Physics

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 lightnings strike the Earth about 4 million times per day. This has led to the cosmic-ray model of lightning initiation:

- Cosmic ray slams into atmosphere and carves a conductive path through a thunderstorm;
- Air showers alone will not increase the conductivity enough to initiate lightning;
- A mechanism of runaway electron avalanche was proposed by A. V. Gurevich, *et al.* (1992) in order to increase ionization;
- Strong electric fields accelerate electrons to nearly the speed of light;
- These electrons emit x-rays and gamma-rays, which were observed by G. Fishman, *et al.* (1994);
- A gamma-ray flash descends from the overhead thundercloud;
- It is not clear why some discharges make x-rays and others do not;
- Gamma-rays are produced inside of thunderstorms;
- Explosive production of energetic particles were observed from space by G. Fishman, *et al.*;
- Thunderstorms create electron and positron beams;
- Thunderstorms produce Terrestrial Gamma-Ray Flashes.

Terrestrial Gamma-Ray Flashes were first detected by chance by NASA's Earth-orbiting Compton gamma ray telescope. Compton was searching for Gamma Ray Bursts from exploding stars, when it unexpectedly began detecting very strong bursts of high energy x-rays and gamma rays, coming from Earth. Detectors observed an unexplained terrestrial phenomenon: brief (lasting about a millisecond), intense flashes of gamma rays. According to G. J. Fishman, *et al.* (1994), *"These flashes must originate in the atmosphere at altitudes above at least 30 kilometers in order to escape atmospheric absorption and reach the orbiting detectors. The photon spectra from the events are very hard (peaking in the high-energy portion of the spectrum) and are consistent with bremsstrahlung emission from energetic MeV electrons. The most likely origin of these high-energy electrons, although speculative at this time, is a rare type of high-altitude electrical discharge above thunderstorm regions"*.

An article "Properties of the thundercloud discharges responsible for terrestrial gamma-ray flashes" by J. R. Dwyer, *et al.* (2013) provides a brief review of TGFs: *"They have durations ranging from a few tens of microseconds to a few milliseconds and produce the highest energy emission of natural phenomena originating from within the Earth's atmosphere. TGFs are relatively common, with a thousand or more produced around the planet each day. Spacecraft measurements have found that the source altitudes of the gamma rays must be below 20 km, within the altitude range of thunderstorms. The spectra of TGFs (up to a few tens of MeV) are consistent with bremsstrahlung emissions from energetic electrons accelerated by strong electric fields within the thunderclouds, although there is currently some debate about the spectra at very high energies (~40–100 MeV). It is a challenge to develop models that can explain how large numbers of high-energy electrons are generated so rapidly deep within the atmosphere"*.

According to J. R. Dwyer (1994), there are two leading models of TGF formation:

1. Lightning leader emission, similar to x-ray emission seen near the ground;
2. Dark Lightning, which:
 - Generates so many high-energy particles that it discharges the thunderstorm faster than normal lightning;
 - Makes currents > 100,000 amps;
 - Emits very little visible light, i.e., appears dark;
 - Can explain Terrestrial Gamma-Ray Flashes;
 - Cosmic rays are not needed.

But how can we explain a new mystery: a bright TGF was seen by spacecraft in the middle of Sahara Desert on a nice day. The nearest thunderstorms were ~ 1000 miles away.

Let's summarize obtained results, which are difficult to explain in frames of the existing models:

- Sometimes Ball Lightning appears without apparent connection to a lightning bolt;
- Unusual surges of radiation at 511 keV when there were no thunderstorms;
- Beams of antimatter (positrons) produced above thunderstorms on Earth;
- A gamma-ray flash coming down from the overhead thundercloud;
- Some discharges make x-rays and others do not;
- Explosive production of energetic particles observed from space;
- Thunderstorms make electron and positron beams;
- Thunderstorms produce TGFs;
- A bright TGF was seen by spacecraft in the middle of Sahara Desert on a nice day;
- The spectra of TGFs at very high energies (~40–100 MeV).

Geocorona is the luminous part of the outermost region of the Earth's atmosphere. It extends to at least 640,000 km from the Earth. X-rays from Earth's Geocorona in the range of energies 0.08-10 keV were first detected in 1999. The main mechanism explaining the geocoronal X-rays is that they are caused by collisions between neutral atoms in the Geocorona with carbon, oxygen and nitrogen ions in the solar wind. This process is called "charge exchange" since an electron is exchanged between neutral atoms in Geocorona and ions in the solar wind.

WUM Explanation. The characteristics of Geocorona are similar to the characteristics of the Solar Corona (we discussed It in the Presentation 6):

- The Geocorona made up of Universe-Created (UC) Particles (UCPs) resembles a honeycomb filled with plasma including the ionosphere from about 60 km to 1,000 km altitude;
- The Geocorona composed of UC Fermions UCF1 (1.3 TeV), UCF2 (9.6 GeV), and UCF3 (3.7 keV) has the size that is much larger than the size of the Earth;
- 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;
- As the result of a large fluctuation of UCPs 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 case they were produced at altitudes of above at least 30 km, they can reach the orbiting detectors. 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. TGFs are, in fact, well-known Gamma-Ray Bursts. X-rays and gamma-rays are the consequence of UCF1 (1.3 TeV), UCF2 (9.6 GeV), and UCF3 (3.7 keV) self-annihilation. The spectra of TGFs at very high energies can be explained by UCF1 and UCF2 self-annihilation;
- 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.

Ball Lightning

Ball Lightning (BL) is an unexplained atmospheric phenomenon that is usually associated with thunderstorms and lasts considerably longer than the split-second flash of a lightning bolt. BL usually appears during thunderstorms, sometimes within a few seconds of lightning, but sometimes without apparent connection to a lightning bolt. In some cases, BL appears after a thunderstorm – or even before it.

In 1972, N. Charman published a review in which he identified the properties of a "typical" Ball Lightning:

- They frequently appear almost simultaneously with cloud-to-ground lightning discharge;
- They are generally spherical or pear-shaped with fuzzy edges;
- Their diameters range from 1cm to several meters, most commonly 10–20 cm;
- They can be seen clearly in daylight;
- The lifetime of each event is from 1 second to over a minute with the brightness remaining fairly constant during that time;
- They tend to move, most often in a horizontal direction at a few meters per second, but may also move vertically, remain stationary or wander erratically;
- Many of them are described as having rotational motion;
- It is rare that observers report the sensation of heat, although in some cases the disappearance of the ball is accompanied by the liberation of heat;

- Some display an affinity for metal objects and may move along conductors such as wires;
- Some appear within buildings passing through closed doors and windows;
- Some have appeared within metal aircraft and have entered and left without causing damage;
- The disappearance of a ball is generally rapid and may be either silent or explosive.

Short History of BL Hypothesis. Different hypothesis were proposed to explain BL, but no one explanation is widely accepted at present:

- Vacuum hypothesis by Nikola Tesla (1904);
- Microwave cavity hypothesis by Peter Kapitsa (1955);
- Antimatter hypothesis by David Ashby and Colin Whitehead (1971);
- Maser-Soliton hypothesis by Peter H. Handel (1975);
- Black hole hypothesis by Mario Rabinowitz (1999);
- Microwave Bubble hypothesis by H.-C. Wu (2014).

Extreme BL Hypothesis. VanDevender (2011) distinguished Extreme Ball Lightning (EBL) from ordinary BL by the following characteristics:

- It glows in air;
- It originates from nothing visible;
- It lasts between 10 and 1200 seconds;
- It is lethal or potentially lethal;
- It causes significant damage;
- It contains energy estimated at 100,000 to 1 billion Joules, far in excess of the energy density attributable to chemicals or electrostatics;
- It penetrates walls, glass and metal, generally without leaving a hole;
- It leaves black streaks on corpses without the spasm of electrocution;
- It can excavate tons of earth.

Extreme BL in County Donegal, Ireland, on August 6, 1868, travelled about 1.6 km and excavated ~ 200 cubic meters of water saturated peat in ~ 1200 second. VanDevender followed up a reputable report by Michael Fitzgerald to the Royal Society with a visit to the site. He confirmed the essentials, as far as it was possible so long after the event. It was evident that the conductive peat would immediately neutralize any charge, so EBL cannot be electrostatic.

According to VanDevender, to date no theory addresses the characteristics of EBL. He said, "It seems to require new physics".

In view of W. Thornhill (2006), explaining EBL doesn't require new physics. The clue of his hypothesis comes from the observed ability of EBL to penetrate solid material. According to Thornhill, there is one stable particle that has the ability to pass through solids without any appreciable effect – neutrino, which in the presence of an excited nucleus may accept a lower level of energy than required for pair production and form a stable "heavy neutrino".

Observations of Characteristics of Ball Lightnings. One particularly large example was reported "On the authority of Dr. Gregory" in 1749:

Admiral Chambers on board the Montague, 4 November 1749, was taking an observation just before noon...he observed a large ball of blue fire about three miles [5 km] distant from them. They immediately lowered their topsails, but it came up so fast upon them, that, before they could raise the main tack, they observed the ball rise almost perpendicularly, and not above forty or fifty yards [35 or 45 m] from the main chains when it went off with an explosion, as great as if a hundred cannons had been discharged at the same

time, leaving behind it a strong sulfurous smell. By this explosion, the main top-mast was shattered into pieces and the main mast went down to the keel. Five men were knocked down and one of them very bruised. Just before the explosion, the ball seemed to be the size of a large mill-stone.

Observation of the Optical and Spectral Characteristics of Ball Lightning was made by J. Cen, *et al.* in 2014. At a distance of 900 m a total of 1.64 seconds of digital video of the BL and its spectrum was obtained, from the formation of the BL after the ordinary lightning struck the ground, up to the optical decay of the phenomenon. The BL traveled horizontally across the video frame at an average speed of 8.6 m/s . It had a diameter of 5 m.

Oscillations in the light intensity and in the oxygen and nitrogen emission at a frequency of 100 Hz, possibly caused by the electromagnetic field of the 50 Hz high-voltage power transmission line in the vicinity, were observed. From the spectrum, the temperature of the BL was assessed as being lower than the temperature of the parent lightning (<15,000–30,000 K). The observed data are consistent with vaporization of soil as well as with ball lightning's sensitivity to electric fields.

A. I. Nikitin, *et al.* (2023) in the article “Explosions of Ball Lightning inside Enclosed Spaces” estimated the value of energy density of highly energetic BL ($\rho = 10^{10} \text{ J/m}^3$) and the energy of the explosion of this ball lightning to be equal to 30–130 MJ. These estimations allowed the authors to say that BL is a dangerous natural phenomenon (see **Figure 1**).



Figure 1. The house wall thrown out by the explosion. Adapted from “Sources and components of ball lightning theory” A I Nikitin et al 2018 J. Phys.: Conf. Ser. 996 012011.

Multiworld

According to A. G. Oreshko (2012), “*P. L. Kapitsa supposed that a ball lightning is a window in another world*”. We analyzed possibility of the existence of other worlds: Micro-world, Small-world, and Large-world based on the proposed Weak, Super-Weak and Extremely-Weak interaction, respectively. It was suggested that BL is an object of the Small-world.

Macro-world. In WUM, strength of gravity is characterized by gravitational parameter G :

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

where $G_0 = \frac{a^2 c^4}{8\pi h c}$ is an extrapolated value of G at the Beginning of the World ($Q = 1$), c is the gravitodynamic constant, h is the Planck constant, and a is a basic size unit:

$$a = 1.7705641 \times 10^{-14} \text{ m}$$

Dimensionless time-varying quantity Q is a measure of the Age of the World: $Q = \tau/t_0$ where τ is a cosmological time and a basic time unit t_0 equals to:

$$t_0 = a/c = 5.9059674 \times 10^{-23} \text{ s}$$

In the present epoch, Q equals to:

$$Q = 0.759972 \times 10^{40}$$

The range of gravity equals to the size of the World R :

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

WUM foresees three additional types of interactions between Universe-Created Particles (UCPs): Weak, Super-Weak, and Extremely-Weak, characterized by the following parameters, respectively:

$$G_W = G_0 \times Q^{-1/4} \propto \tau^{-1/4}$$

$$G_{SW} = G_0 \times Q^{-1/2} \propto \tau^{-1/2}$$

$$G_{EW} = G_0 \times Q^{-3/4} \propto \tau^{-3/4}$$

In our view, each type of UCPs' interactions provides integrity of the corresponding world.

Micro-world is characterized by the parameter G_W , which is about 30 orders of magnitude greater than G . The range of the weak interaction R_W for UCP with Compton length L_{UCP} in the present epoch equals to:

$$R_W = L_{UCP} \times Q^{1/4}$$

For example, particles UC Fermion UCF1 with the rest energy E_{UCF1} :

$$E_{UCF1} = \alpha^{-2} \times E_0 = 1.315 \text{ TeV}$$

where α is a dimensionless Rydberg constant and a basic energy unit E_0 equals to:

$$E_0 = hc/a = 70.025 \text{ MeV}$$

have Compton length L_{UCF1} :

$$L_{UCF1} = \alpha^2 \times a = 0.94285 \times 10^{-18} \text{ m}$$

and the range of the Weak interaction:

$$R_{UCF1}^W = L_{UCF1} \times Q^{1/4} = 0.88 \times 10^{-8} \text{ m}$$

that is much greater than the range of the weak nuclear force ($10^{-16} - 10^{-17} \text{ m}$).

Small-world is characterized by the parameter G_{SW} , which is about 20 orders of magnitude greater than G . The range of the super-weak interaction R_{SW} for the particles UCF1 equals to:

$$R_{SW} = L_{UCF1} \times Q^{1/2} = 82.2 \text{ m}$$

In WUM, Ball Lightnings (BLs) are Macroobjects (MOs), which have Cores made up of weakly interacting particles UCF1, surrounded by shells composed of the electron-positron plasma contaminated by chemical elements of soil and air as the result of TGF strike of the ground. Super-weak interaction between particles UCF1 and all particles around the Core provides integrity of BLs.

Large-world is characterized by a parameter G_{EW} , which is about 10 orders of magnitude greater than G . The range of the extremely-weak interaction R_{EW} in the present epoch equals to:

$$R_{EW} = a \times Q^{3/4} = 1.44115 \times 10^{16} m = 1.5233 ly = 96,335 AU$$

In our view, Extra Solar Systems (ESS) are Large-World objects. Extremely-weak interaction between Universe-Created Matter (UCM) Cores and all particles around them provide ESS integrity.

Ball Lightning Formation

The clue of our model comes from the observed ability of BLs to penetrate solid materials. It means that the Core of BL should be composed of UCPs. Following Tesla vacuum hypothesis, we suppose that when sudden and very powerful TGF passes through the air and strike the surface of the Earth, *“the tremendous expansion of some portions of the air and subsequent rapid cooling and condensation gives rise to the creation of partial vacua in the places of greatest development of heat. These vacuous spaces, owing to the properties of the gas, are most likely to assume the shape of hollow spheres when, upon cooling, the air from all around rushes in to fill the cavity created by the explosive dilatation and subsequent contraction”*.

In WUM, the places of greatest development of heat are the spots on the Earth’s surface struck by TGFs. As a result, the ablation of the soil takes place and vaporized chemical elements of soil and the oxygen and nitrogen from the air can be absorbed by BLs and observed experimentally. Very powerful gamma quants with energy at least 1.02 MeV in the vicinity of atomic nuclei of the ground can produce electron-positron pairs with high concentration. This collisionless unmagnetized electron-positron plasma, whose properties are very well studied, composes a shell around UCM core of BL made up of UCF1 and provides their affinity for metal objects such as wires.

The most important part of the BL formation is UCM core. The calculated density of Geocorona composed of particles UCF1 ρ_{DMF1} near the surface of the Earth is:

$$\rho_{UCF1} \cong 2.5 \times 10^{-7} kg/m^3$$

Let us calculate a radius of a sphere in Geocorona R_{GC} having mass about Planck mass M_p :

$$R_{GC} = 0.275 m$$

that is a reasonable size of Geocorona bubble. UCM core of the BL has a maximum energy E_{BLC} :

$$E_{BLC} = 1.96 \times 10^9 J$$

that corresponds to the estimated by VanDevender value of $(10^5 - 10^9) J$ and by A. I. Nikitin, *et al.* value of $(30 - 130) \times 10^6 J$.

In accordance with **Vacuum hypothesis** by N. Tesla, when powerful TGF strikes a surface of the Earth, the explosive dilatation of the portion of Geocorona with radius R_{GC} gives rise to the creation of hollow sphere with partial vacua and all UCPs outside of the sphere. The subsequent rapid contraction induces UCPs rush in to fill the cavity. As the result, at the center of the sphere arises microobject with mass $\sim M_p$ and density high enough for the beginning of the UCPs self-annihilation.

According to WUM, all gravitationally-rounded Macroobjects in hydrostatic equilibrium, down to the moon of the Saturn Mimas, have UCM Reactors inside of them. Considering that the mean density of the Mimas is $1.15 \times 10^3 kg/m^3$ with the UCM Core made up of self-annihilating UCF1, we can estimate an average density of the Core about $\sim 10^3 kg/m^3$ as the minimum density for the effective self-annihilation. Then, the size of the Core is about $\sim 10^{-4} m$. Mass of the small BLs is mostly in the UCM cores. Then they can easily penetrate through walls, glasses, metals, without leaving a hole.

Considering the density of the atmosphere $\rho_{atm} \cong 1.25 \text{ kg/m}^3$ we can calculate the minimum radius of the BL r_{min} corresponding to the core's mass only:

$$r_{min} \cong 0.16 \text{ cm}$$

that is in good agreement with experimentally observed value of BL minimum size about $\sim 1 \text{ cm}$. We take density of the atmosphere ρ_{atm} for the average BL density to explain movement of BL in air.

Practically all mass of EBLs is in the electron-positron plasma. EBL with diameter 5 m observed by Cen, *et al.* in 2014 had a mass of about 82 kg.

As the conclusion:

- BL belongs to the Small-world;
- BL has the core made up of UCF1 surrounded by the electron-positron plasma contaminated by chemical elements of soil and air as the result of TGF strike of the ground;
- The core of BL irradiates quants with different energies and attracts new UCPs from Geocorona due to super-weak interaction. It explains the observed result that the brightness of BL remains fairly constant during its lifetime;
- UCPs supply not only additional mass, but also additional angular momentum. It explains the fact that many of BLs are described as having rotational motion.

Tunguska Event

Observations. On June 30, 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 (an 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 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 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 1,000 km in diameter. The total mass of the asteroid belt is about 3% that of the Moon.

WUM Explanation

Main results of Meteor Air Bursts are:

- They are 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;
- Comets are leftovers from the dawn of SS around 4.6 billion years ago and consist mostly of ice coated with dark organic material. They have been referred to as "dirty snowballs";
- How and when comets formed is debated, with distinct implications for SS formation.

Asteroids and Comets Formation. In frames of WUM, Ecliptic comets were produced by the Sun itself as the result of Volcanic Rotational Fission of the Sun's UCM 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 the Rotational Fission of their UCM cores.

In our view, Random Explosive Volcanic Rotational Fission of the Sun's UCM Core looks like a Firework of UCM 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.

UCM cores of satellite objects can be any size from 1 m to thousands of kilometers. Satellites are rocky, metallic or icy bodies as the result of the self-annihilation of UCPs inside of their cores in case when a density of cores $\geq 10^3 \text{ kg/m}^3$ that is enough for the efficient self-annihilation. 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 UCM cores of satellite is $< 10^3 \text{ kg/m}^3$ the self-annihilation process is not efficient. Then, there is a possibility of stable UCM Bolides, which are the analog of Extreme Ball Lightnings (EBLs) with much larger internal energy. The range of Weak interaction for particles UCF1 is:

$$R_{UCF1}^W = 0.88 \times 10^{-8} \text{ m}$$

and a calculated minimum particles concentration is:

$$n_{UCF1} = 1.47 \times 10^{24} \text{ m}^{-3} .$$

Considering the rest energy of UCF1:

$$E_{UCF1} = 1.315 \text{ TeV} = 2.11 \times 10^{-7} \text{ J} ,$$

we can calculate the minimum energy density of UCM core:

$$\rho_{UCF1} = 3.1 \times 10^{17} \text{ J/m}^3$$

that is equivalent to the mass density of 3.44 kg/m^3 that is not enough for the efficient self-annihilation. Tunguska Superbolide had the calculated maximum energy

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

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

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

In our view, Weak interaction of particles UCF1 provides the integrity of the Superbolides' core and Super-weak interaction – of the Superbolide itself. Tunguska Superbolide is 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 UCM cores' energy density up to the critical value of 10^3 kg/m^3 when the efficient self-annihilation of particles UCF1 took place and UCM core exploded.

Conclusion

It is important to emphasize that the initial energy required for a BL/EBL creation is insufficient for its sustenance of up to 1200 seconds. Additional energy, therefore, must be consumed by a BL/EBL once it had been formed. WUM predicts a new phenomenon – a generation of BLs according to the proposed model of them. Once we master the creation of BLs and EBLs in a controlled environment, we can concentrate our efforts on harvesting that energy from a practically infinite Source – the Medium of the World with UCPs.

World – Universe Model can serve as a basis for High-Energy Atmospheric Physics.

Presentation 8. Classical Physics [12][15][16][20][28][30][36]

Introduction

Classical Physics is a branch of Physics that should be described by classical notions, which define emergent phenomena. An Emergent Phenomenon is a property that is a result of simple interactions that work cooperatively to create a more complex interaction. Physically, simple interactions occur at a microscopic level, and the collective result can be observed at a macroscopic level. The developed Hypersphere 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". In WUM, Space, Time, Gravity, Temperature, Mass are all emergent phenomena. There is basic size unit $a \cong 10^{-14}$ m in Classical Physics, no less.

We stress 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!**

According to Contemporary Physics, Classical Physics (pre-1900 physics) is a group of physics theories that predate modern, more complete and widely applicable theories. Modern Physics (post-1900 physics) incorporates elements of Quantum Physics and Relativity. How Classical Physics can incorporate elements of Quantum Physics in Modern Physics? I do not get it. To be clear, I 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 is proportional to the **average kinetic energy of its particles**. 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. 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**. Black-body spectrum of MBR is due to thermodynamic equilibrium of photons with the Intergalactic plasma, the existence of which is experimentally proved by Fast Radio Bursts.

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.

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

Minkowski Spacetime is a combination of three-dimensional **Euclidean Space** and **Time** into a **4-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. Because it treats time differently than it treats 3 spatial dimensions, Minkowski spacetime differs from four-dimensional Euclidean space.

In **WUM**, the World is a **Hypersphere of 4D Nucleus of the World**, which is, in fact, a 4D Bubble with a low density in the present Epoch. It is expanding in Its fourth spatial dimension. As a result, the Hypersphere is evenly stretched. All points of the Hypersphere are equivalent; there are no preferred centers or boundaries of the World. A Hypersphere is an example of **3-Manifold (3M)**, which locally behaves like regular Euclidean 3D space: just as a sphere looks like a plane to small enough observers. **3M 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 the Absolute Temperature T 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 (SS) and **Cosmic Time** of the General Relativity. It is defined by the **Impedance** (Wave Resistance) of the Medium that equals to the Hubble's parameter H . 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 absolute Age of the World.

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

Medium of the World

Timeline of Luminiferous Aether:

- 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 theorized that light is a wave propagating through 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 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) aether 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 aether, 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 aether 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. McCullagh's Aether can transmit transverse waves. He 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–Lemaître–Robertson–Walker metric and a **perfect fluid** with a given mass density ρ and pressure p , which is a **medium** of the universe. The medium exists or not?

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 "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 Universe-Created Particles. 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. Relative to MBR rest frame the Milky Way (MW) galaxy and the Sun are moving with the speed of 552 and 370 $km\ s^{-1}$, respectively. 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.

Dark Matter

The history of Dark Matter (DM) can be traced back to at least the end of the 18th century. In 1783, J. Michell was the first to propose the existence of "dark stars". He 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. G. Bertone and D. Hooper (2018) provide an excellent review of DM history:

- In 1844, F. Bessel argued that the observed proper motion of the stars Sirius and Procyon could only be explained by the presence of faint companion stars influencing the observed stars through their gravitational pull;
- In 1904, Lord Kelvin was among the first to attempt a dynamical estimate of the amount of dark matter in MW. His argument was simple yet powerful: if stars in MW can be described as a gas of particles, acting under the influence of gravity, then one can establish a relationship between the size of the system and the velocity dispersion of the stars;
- H. Poincare was impressed by Lord Kelvin's idea of applying the "theory of gases" to the stellar system of MW. In 1906, he explicitly mentioned "dark matter" and argued that since the velocity dispersion predicted in Kelvin's estimate is of the same order of magnitude as that observed, the amount of dark matter was likely to be less than or similar to that of visible matter.

Universe-Created Matter

In **WUM**, Dark Matter is "dark" when astronomers observe the World with telescopes only in a visible spectrum. The contemporary Astronomy allows us to observe the World in wavelengths from radio waves up to gamma rays! Then, they are not "dark" at all. The first known binary system was Cygnus X1 (1971) that is typically the brightest persistent source of **hard X-rays with energies up to 60 keV**. In 2000, R. Minchin, *et al.* discovered binary galaxy system VIRGOHI 21 with NGC 4254, which has a **21-cm emission**.

WUM proposes multicomponent Universe-Created (UC) Matter (UCM) system consisting of two couples of co-annihilating UC Particles (UCPs): a heavy UC Fermion (UCF) – UCF1 (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 that we will discuss below); a heavy fermion – UCF2 (9.6 GeV) and a light spin-0 boson – ELOP (340 keV) that is a dipole of preons with electrical charge $e/3$; UCF3 (3.7 keV), UCF4 (0.2 eV), and boson XION (5.3 μeV).

The reason for this multicomponent UCM system was to explain:

- The diversity of Very High Energy gamma-ray sources in the World;
- The diversity of UCM Cores of Macroobjects of the World (Superclusters, Galaxies, and Extrasolar Systems), which are Fermion Compact Objects and UCM Reactors in WUM.

UCPs do not possess an electric charge. Their masses cannot be directly measured by mass spectrometry. Hence, they can be observed only indirectly. The signatures of UCPs self-annihilation with expected rest energies of 1.3 TeV; 9.6 GeV; 70 MeV; 340 keV; 3.7 keV; 0.2 eV; 5.3 μeV are found in spectra of diffuse gamma-ray background and the emissions of various MOs in the World. We connect observed gamma-ray spectra with the structure of MOs (nuclei and shells composition). Self-annihilation of those UCPs 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.

Gravity

In 1687, Newton published a groundbreaking book called “Mathematical Principles of Natural Philosophy”, in which he 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*”.

Le Sage’s Theory of Gravitation is a kinetic theory of gravity originally proposed by Fatio in 1690 and later by Le Sage in 1748. The theory proposed mechanical explanation for Newton 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 ultra-mundane corpuscles because he supposed them to originate **beyond our known universe**. It was a genius prediction of Universe-Created Particles **XIONS** in WUM! The distribution of ultramundane flux is isotropic, and laws of its propagation are similar to that of light;
- He suggested that the ultra-mundane 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 10^7 th 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, the ultra-mundane 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:

- XIONS ($5.3 \mu eV$) are “ultramundane corpuscles”, which created by the Universe;
- XIONS are ultra-relativistic UCPs;
- Proposed Weak interaction between XIONS and Matter provides mass proportionality. Energy density of XIONS in the World about 64% of the total density provides high intensity of their flux;
- Gravitational mass m_g is a classical notion that defines Gravity – the emergent phenomenon. 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 .

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.

In WUM, **Gravity is not an interaction but a manifestation of the Medium.**

Emergent Gravity, Space and Time

C. Barcelo, *et al.* (2011) 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.*

In **WUM**, 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.*

Maxwell's Equations

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. 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. O. Ludwig in his article "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. The effects attributed to dark matter can be simply explained by the gravitomagnetic field produced by the mass currents.*

The explanation of galactic rotation curves made by G. Ludwig is in good agreement with **WUM**.

Fundamental Physical Constants

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: $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$ we make measurable the **most important constants** as follows:

- Basic size unit a :
$$a = 0.5[8(\mu_0 h/c)^3 R_\infty R_T^6]^{1/5} = 1.7705641 \times 10^{-14} \text{ m}$$

- 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 “Fine-structure constant.”

In WUM we introduce the following Basic Units:

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

Dirac Large Number Hypothesis

In 1937, Paul Dirac in the paper “A new basis for cosmology” said: “*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. The gravitational constant will be inversely proportional to the epoch*”.

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 :

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

WUM holds that there indeed exist **simple mathematical relations** between all Primary Cosmological Parameters that depend on Q :

- 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 Primary Cosmological Parameters, which are in good agreement with the latest results of their measurements.

Creation of Matter

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*".

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

WUM: The 3M World, which is a Hypersphere of 4D Nucleus, was started by a fluctuation in the Eternal Universe. 4D Nucleus is expanding in Its fourth spatial dimension, and its surface, the Hypersphere, is evenly stretching. 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.

UCM is created by the Universe in the 4D Nucleus of the World. UCPs carry new UCM into the 3M Hypersphere World. Ordinary Matter is a byproduct of UCPs self-annihilation. Consequently, a matter-antimatter asymmetry problem discussed in literature does not arise (since antimatter does not get created by UCPs self-annihilation).

By analogy with 3D ball, which has a 2-Manifold (2M) sphere surface (that has surface energy), we can imagine that the 3M 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 4D Nucleus of the World 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 UCM occurs homogeneously in all points of the Hypersphere World.

Primary Notions

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 Big Bang model.

In **WUM**, this Principal is valid at the cosmological times $\tau \geq \tau_M \cong 10^{-18} s$, 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, this 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 follows from the rotation invariance (rotation about x, y, z axes). In my opinion, Angular Momentum problem is the killer of all existent cosmological models including Big Bang model. Old-timers of Cosmology should solve this problem.

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

Maxwell's Equations form a foundation of classical Electromagnetism 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 in Classical Physics.

Main Results of WUM

Predictions

Summary of the calculated by WUM in 2013 cosmological parameters and experimentally measured parameters are presented in the following Table.

Parameter	Calculated (2013)	Measured	Year
Gravitational	$6.67420 \times 10^{-11} m^3 kg^{-1} s^{-2}$	$6.674184 \times 10^{-11} m^3 kg^{-1} s^{-2}$	2018
Hubble's	$68.733 km s^{-1} Mpc^{-1}$	$68.7 \pm 1.3 km s^{-1} Mpc^{-1}$	2021
Ionized Baryons	4.8 %	$4.9 \pm 1.3 \%$	2016
Minimum Photon Energy	$1.87433 \times 10^{-14} eV$	$\lesssim 2.2 \times 10^{-14} eV$	2017
MBR Temperature	2.725245 K	$2.72548 \pm 0.00057 K$	2009
FIRB Temperature Peak	28.955 K	29 K	1998
Absolute Age of the World	14.226 Byr		

We emphasize that WUM allows for precise calculation of values that were only measured experimentally earlier and makes verifiable predictions.

“The Discovery of a Supermassive Compact Object at the Centre of Our Galaxy” (Nobel Prize in Physics 2020) made by R. Genzel and A. Ghez is a confirmation of one of the most important predictions of WUM in 2013: *“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”*.

JWST discoveries confirm the most important predictions of WUM in 2018: 1) Absolute Age of World is 14.22 Byr; 2) Dark Epoch (spanning for Laniakea Supercluster (LSC) from the Beginning of World for 0.45 Byr) when only UCM Macroobjects (MOs) form and evolve; 3) Luminous Epoch (ever since, 13.77 Byr for LSC) when Luminous MOs (superclusters, galaxies, extrasolar systems, etc.) emerge; 4) Transition from Dark Epoch to Luminous Epoch is due to Explosive Rotational Fission of Overspinning (surface speed at equator exceeding escape velocity) UCM Supercluster’s Cores and self-annihilation of UCPs; 5) MOs of the World form from top (Superclusters) down to Galaxies and Extrasolar systems in parallel around different Cores made up of different UCPs; 6) 3M Finite Boundless World presents a Patchwork Quilt of different Luminous Superclusters, which emerged in different places of World at different Cosmological times.

Explained Problems

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

- Angular Momentum problem in birth and subsequent evolution of Galaxies and ESS explained by Volcanic Rotational Fission of Overspinning UCM 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 above and below Galactic center—are stable clouds of UCPs (UCF1, UCF2, and UCF3) containing uniformly distributed UCM Objects, in which UCPs self-annihilate and radiate gamma rays;
- Galaxies are ellipticals and spirals due to Explosive Rotational Fission of their Overspinning UCM 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, multi-charged 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 UCPs. The Solar corona made up of UCPs 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 UCPs by Cores. UCPs 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 UCM Reactors inside of all MOs fueled by UCPs. Internal Heating is due to UCPs self-annihilation;
- Diversity of Gravitationally-Rounded Objects in SS is explained by UCM Reactors inside of MOs fueled by UCPs. All chemical elements, compositions, radiations are produced by MOs themselves as the result of UCPs self-annihilation in their different UCM 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 UCF1 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 UCM core absorbs new UCPs, and its size is increasing in time $\propto \tau^{1/2}$. Hence, there is an expansion of UCM core, and its surface (the Upper mantle with Crust) is stretching. Due to UCPs 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 UCM cores absorb new UCPs, 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 67.6% of what it is today;
- Matter-Antimatter Asymmetry problem. Ordinary Matter is a byproduct of UCPs self-annihilation. This problem does not arise, since antimatter does not get created by UCPs 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 a self-annihilation of UC particles UCF4 (0.2 eV);
- Solar Corona, Geocorona and Planetary Coronas made up of UCPs resemble honeycombs filled with plasma particles (electrons, protons, multi-charged ions), which are the result of UCPs self-annihilation;
- Lightning Initiation problem and Terrestrial Gamma-Ray Flashes are explained by the self-annihilation of UCPs in Geocorona;
- Ball Lightnings are objects that have cores made up of UCPs 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 UCPs.

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 87 years of Dirac's proposals, it is high time to make a Paradigm Shift in Cosmology and Classical Physics.

Essence of WUM

In 1937, P. Dirac proposed a Large Number Hypothesis and Hypothesis of Variable Gravitational Constant, later incorporating a concept of Continuous Creation of Matter in universe. Hypersphere World-Universe Model (WUM) builds upon these ideas, introducing a distinct mechanism for Matter creation. We demonstrate that WUM is a natural extension of Classical Physics and has the potential to catalyze a change in basic assumptions in both Cosmology and Classical Physics.

WUM vs Big Bang Model (BBM)

WUM is proposed as alternative to the prevailing Big Bang Model (BBM). It is well-known that any theory is based on certain hypotheses. WUM and BBM are fundamentally different models with fundamentally different hypotheses:

1. Initial Conditions:

- **BBM:** Proposes an initial singularity with infinite energy density and extremely rapid expansion of spacetime (inflation).
- **WUM:** Suggests a fluctuation that created a 4D Nucleus of the World with an extrapolated radius equal to the basic size unit a . This Nucleus had a finite extrapolated energy density (about 10^4 times less than nuclear density) and expanded in the fourth spatial dimension at the speed c (the gravitodynamic constant), resulting in the even stretching of the World.

2. Structure of the World:

- **BBM:** Assumes almost infinite homogeneous and isotropic universe around initial singularity.
- **WUM:** Describes a 3D finite boundless World (a Hypersphere of the 4D Nucleus) as a Patchwork Quilt of various main luminous superclusters ($\gtrsim 10^3$), which emerged in different regions of the World at different cosmological times.

3. Medium of the Universe:

- **BBM:** Often implies a vacuum state in the early universe.
- **WUM:** Proposes that the World's Medium consists of protons, electrons, photons, neutrinos, and Universe-Created Particles (UCPs), previously referred to as "Dark Matter Particles". Medium is homogeneous and isotropic, while the distribution of macroobjects is spatially inhomogeneous, anisotropic, and temporally non-simultaneous. The rejection of the luminiferous aether in 1905 was a significant moment for Classical Physics; however, the Medium proposed by WUM could be considered a revival of this concept, acting as a savior for Classical Physics.

4. Conservation Laws:

- **BBM:** Does not explicitly emphasize the conservation of angular momentum in its foundational principles.
- **WUM:** Stands out as the only cosmological model consistent with the fundamental law of conservation of angular momentum.

5. Macroobjects Formation:

- **BBM:** Macroobjects form from a Bottom (Extrasolar Systems) up to Galaxies and Superclusters.
- **WUM:** Macroobjects form from a Top (Superclusters) down to Galaxies and Extrasolar Systems due to an Explosive Rotational Fission of Superclusters Overspinning Cores made up of UCPs, which were created

by the Universe during Dark Epoch for 0.45 Byr. Formation of Galaxies and Extrasolar Systems is not a process that concluded ages ago; instead, it is ongoing.

In conclusion, WUM presents radically different approach to understanding the World compared to BBM challenging long-held assumptions and offering new perspectives on the fundamental nature of Cosmology and Classical Physics.

In my opinion, the hypotheses of BBM are predominantly mathematical, while those of WUM are more physical in nature. Both models may seem incredible, but there is a key difference: BBM fails to explain many of the experimental results observed by contemporary astronomy, such as those from the James Webb Space Telescope (JWST), whereas WUM does. The validity of hypotheses can only be confirmed through experimental results. As R. Feynman famously said, "*It doesn't make any difference how beautiful your guess is, it doesn't make any difference how smart you are, who made the guess, or what his name is. If it disagrees with experiment, it's wrong. That's all there is to it!*"

Recent experimental findings include:

- **JWST Discoveries:** *A new all-time record! JWST's discovery of JADES-GS-z14-0 pushes the earliest galaxy ever seen to just 290 million years after the Big Bang. This new record-holder is remarkably, unexpectedly bright. Five times brighter than the prior (JADES-GS-z13-0) record-holder, JADES-GS-z14-0 is even shockingly visible to MIRI's eyes. But this galaxy is extremely dust-poor. The lack of dust inside JADES-GS-z14-0 presents a novel puzzle.*
- **Earth's Subsurface Ocean:** *An ocean vaster than all the water on Earth's surface combined, hidden 700 kilometers beneath our feet. This is the mind-boggling discovery scientists at Northwestern University (2024) have unveiled, shaking our understanding of where Earth's water comes from.*

These experimental results are inexplicable within framework of BBM but can be readily explained by WUM.

Main pillars of WUM are Medium of World, Universe-Created Matter, and Angular Momentum.

Universe-Created Matter

In my previous manuscripts, I adhered to the standard paradigm of "Dark Matter." However, this concept does not align perfectly with the Hypersphere World-Universe Model (WUM), which posits that the World consists of ordinary matter particles: protons, electrons, photons, and neutrinos. Additionally, WUM introduces a new category of particles, created by the Universe itself—Universe-Created (UC) Particles (UCPs), constituting a novel form of "Universe-Created Matter" (UCM).

These particles are "dark", optically invisible, when observed by astronomers using telescopes only. Modern astronomy, however, enables us to observe the World across a broad range of wavelengths, from radio waves to gamma rays. Under such observation, these particles are not "dark" at all. For instance, the first known binary system, Cygnus X-1 (discovered in 1971), is the brightest persistent source of hard X-rays with energies up to 60 keV. Similarly, a binary galaxy system VIRGOHI 21 with NGC 4254 (discovered in 2000) exhibits 21-cm emission.

The two types of matter—ordinary and UC—have different origins of radiation:

- **Ordinary Matter:** Radiates electromagnetic waves ranging from radio waves to X-rays, emitted by electrons outside the nuclei.
- **Universe-Created Matter:** Radiates gamma rays, which are emitted by nuclei as a result of the self-annihilation of UCPs with rest energies spanning eighteen orders of magnitude.

This distinction underscores the unique nature of UCM and its role in the broader context of the World as described by WUM.

Creation of Matter

WUM proposes that the surface of the Nucleus is created through a process analogous to sublimation. This continuous creation of matter results from this process, where surfaces are intrinsically more energetically favorable than the bulk of a material, creating a driving force for surface formation.

In the WUM framework, the Universe is responsible for creating UCM in the 4D Nucleus of the World. UCPs transport new UCM into the World, and ordinary matter is produced as a byproduct of the self-annihilation of UCPs. By analogy, just as a 3D ball has a 2D spherical surface with surface energy, we can imagine that the 3D Hypersphere World has a "Surface Energy" associated with the 4D Nucleus. The growth of the surface of the 4D Nucleus corresponds to an increase in the World's "Surface Energy."

This proposed 4D process is responsible for the expansion of the 4D Nucleus, the stretching of the 3D World, the creation of matter, and the arrow of time. This constitutes the main hypothesis of WUM. In this view, the arrow of cosmological time is not dependent on any physical phenomenon in the Medium of the World but is a result of the Nucleus expansion driven by the force favoring surface creation.

It is important to emphasize that the creation of matter is a direct consequence of the Nucleus expansion. The creation of UCM occurs homogeneously at all points of the Hypersphere World, underscoring the uniform nature of this process throughout the World.

Stretching of the World

The 4D Nucleus of the World expands along its fourth spatial dimension, with the radius R increasing at a constant speed c , the gravitodynamic constant. This expansion results in the even stretching of its surface, the 3D Hypersphere.

To understand the stretching of the Hypersphere World, imagine an ant residing on the seemingly two-dimensional surface of a balloon. As the balloon is inflated, its radius increases, and its surface area grows. Consequently, the distance between any two points on the surface also increases. The ant perceives its world expanding but does not observe a preferred center. The center of this expansion is not on the surface but rather exists in the inaccessible third dimension, at the center of the balloon.

Similarly, the 4D Nucleus of the World expands along an imperceptible fourth dimension. The center of the World resides at the center of the 4D Nucleus, within this inaccessible fourth dimension. Although we do not perceive the curvature of our 3D Hypersphere World, we do observe its stretching without a discernible center.

According to WUM, all parameters of the World that depend on Q , the ratio of the radius R to the basic size unit a ($Q = R/a$), reflect the World's curvature in the fourth spatial dimension. We introduce the radius of curvature in the fourth spatial dimension as $R = a \times Q$ to provide insight into the curved nature of the World.

In WUM, local physics is linked to the large-scale structure of the Hypersphere World through the dimensionless quantity Q . This approach aligns with Mach's principle: "*Local physical laws are determined by the large-scale structure of the universe.*" Applied to WUM, this means that all parameters of the World depending on Q are manifestations of the World's curvature in the fourth spatial dimension.

Eternal Universe

What can we speculate about the Eternal Universe? It can be envisioned as a "Live Medium" with the "Internal Life." By analogy with the 3D Medium of our World, which experiences internal movements and

resulting 3D fluctuations in density, we can suppose that the Eternal Universe has similar properties, exhibiting 4D fluctuations. One such fluctuation reached a critical size equal to a basic size unit a and began to expand at speed c . Its surface, a Hypersphere, became our World. This marks the Beginning of the World.

A key feature of the Eternal Universe is the creation of Universe-Created Matter (UCM) in the 4D Nucleus of the World, which has a Hypersphere surface that is our World. This is why I assert that WUM represents a paradigm shift in Cosmology.

Universe-Created Matter is abundant:

- 2.4% of ordinary matter is in superclusters, galaxies, stars, planets, etc.
- 4.8% of ordinary matter is in the Medium of the World.
- The remaining 92.8% is UCM.

Universe-Created Matter is omnipresent:

- Two-thirds of the total UCM is in the Medium of the World.
- One-third of the total UCM is in the macroobjects of the World.
- It exists in the cores of all macroobjects of the World.
- It is present in UCM reactors in the cores of all gravitationally-rounded macroobjects.
- It is found in the coronas of all gravitationally-rounded macroobjects of the World.
- It is present in Fermi Bubbles.

In summary, the Eternal Universe is characterized by its dynamic creation of UCM, which pervades all aspects of the World, supporting the view that WUM offers a transformative perspective on Cosmology.

Dimensionless Numbers

There are many competing cosmological models, but in my view, the most probable model is one built on the minimum number of parameters. WUM is based on only two parameters: the dimensionless Rydberg constant α and a time-varying dimensionless quantity Q , which increases over time ($Q \propto \tau$) and serves as a measure of the size and age of the World. The World's energy density is proportional to Q^{-1} at all cosmological times, and relative energy densities of particles are proportional to different exponents of α .

In WUM, we frequently use well-known physical parameters, recognizing that all of them can be expressed through the Basic Units of time (t_0), size (a), and energy (E_0). By considering the relative values of physical parameters in terms of these Basic Units, we can express all dimensionless parameters of the World through α and Q in various rational exponents, as well as small integer numbers and π . WUM posits that there are no fundamental physical constants. In our opinion, the constant α and the quantity Q should be named the "Universe Constant" and the "World Parameter," respectively.

Predictions

In 2013, WUM predicted the values of several cosmological parameters, including:

- Gravitational constant;
- Concentration of intergalactic plasma;
- Relative energy density of baryons in the medium of the universe;
- Minimum energy of photons.

These predictions were confirmed through experiments conducted between 2015 and 2018. The model allows for precise calculation of values for Hubble's parameter, the temperature of the microwave background radiation, and the temperature of the far-infrared background radiation peak, which were experimentally measured earlier. WUM also makes verifiable predictions.

One notable confirmation of WUM's predictions came with the 2020 Nobel Prize in Physics, awarded for the discovery of a supermassive compact object at the center of our galaxy by Prof. R. Genzel and A. Ghez. This discovery supports WUM's 2013 prediction that macroobjects in the World have cores made up of UC particles, with other particles, including UC Matter and baryonic Matter, forming shells around these cores.

Future Observations

WUM predicts the existence of Universe-Created Particles (UCPs) with rest energies of 1.3 TeV, 9.6 GeV, 70 MeV, 340 keV, 3.7 keV, 0.2 eV, and 5.3 μeV . Future efforts should focus on observing cosmic gamma-rays with spectral lines corresponding to these predicted UCPs rest energies. These observations would provide further confirmation of WUM and deepen our understanding of the World's fundamental structure.

Direct Observational Evidence Supporting WUM

The following observations provide direct evidence supporting the validity of WUM:

1. **Microwave Background Radiation and Intergalactic Plasma:** These phenomena support the existence of the Medium that permeates the World.
2. **Laniakea Supercluster:** This supercluster, with a binding mass of approximately $\sim 10^{17} M_{\odot}$ is home to the Milky Way (MW) galaxy and about $\sim 10^5$ other nearby galaxies. These galaxies did not originate from an Initial Singularity, aligning with WUM's predictions.
3. **Milky Way and Virgo Supercluster:** The Milky Way is gravitationally bound to the Virgo Supercluster (VSC) and has an orbital angular momentum calculated based on a distance of 65 million light-years (Mly) from the VSC and an orbital speed of approximately 400 km/s. This orbital angular momentum far exceeds the rotational angular momentum of the Milky Way.
4. **Mass-to-Light Ratio of Virgo Supercluster:** The mass-to-light ratio of the Virgo Supercluster is about 300 times greater than the solar ratio. Similar ratios have been observed in other superclusters, which strongly suggests the presence of significant amounts of UCM in the World.
5. **Distant Galaxies:** Astronomers have discovered the most distant galaxy, HD1, approximately 13.5 Bly away. WUM predicts the discovery of galaxies at distances up to around 13.8 Bly.

These observations collectively support the hypotheses and predictions of WUM, reinforcing its validity as a model for understanding the World.

Problems Explained by WUM

The Hypersphere World-Universe Model (WUM) addresses several significant issues in contemporary cosmology and astrophysics through the introduction of UCPs and their interactions:

- **Angular Momentum Problem:** WUM explains the distribution and evolution of angular momentum in the birth and subsequent evolution of galaxies and extrasolar systems.
- **Missing Baryon Problem:** WUM accounts for the discrepancy between the observed amount of baryonic matter and theoretical predictions.
- **Fermi Bubbles:** These large structures in gamma-rays and X-rays above and below the Galactic center are explained through WUM.
- **Coronal Heating Problem:** WUM provides a solution for why the temperature of the Sun's corona exceeds that of its photosphere by millions of degrees.
- **Rotational Dynamics of the Sun and Earth:** WUM explains why the cores of the Sun and Earth rotate faster than their surfaces.

- **Diversity and Internal Heating of Solar System Objects:** WUM accounts for the diverse characteristics and internal heating mechanisms of gravitationally-rounded objects in the Solar System.
- **Faint Young Sun Paradox:** WUM addresses the apparent contradiction between the presence of liquid water early in Earth's history and the astrophysical expectation that the Sun's output was only 70% as intense as it is today.

Ball Lightning

In WUM, Ball Lightnings (BLs) are objects with cores composed of UCPs, surrounded by electron-positron plasma shells contaminated with chemical elements from the soil and air, resulting from Terrestrial Gamma-Ray Flash strikes on the ground. It is important to emphasize that the initial energy required for the creation of BLs is insufficient to sustain them for up to 1200 seconds. Therefore, additional energy must be consumed by BLs once they are formed. By mastering creation of BLs in controlled environment, we can focus on harnessing that energy for practical use.

These explanations demonstrate WUM's potential to solve a range of complex problems in modern Cosmology and Astrophysics, highlighting its value as a comprehensive theoretical framework.

Conclusion

The Hypersphere World-Universe Model (WUM) aligns with all major concepts of the World. It effectively describes primary cosmological parameters and their interrelationships, spanning scales from cosmological structures to elementary particles. WUM enables precise calculations of values that were previously determined only through experimental measurement and makes verifiable predictions. The remarkable consistency between calculated values and observational data provides significant confidence in the model. While WUM requires further development, it is already a robust foundation for a new physics paradigm, as proposed by Paul Dirac in 1937.

Inter-Connectivity of Primary Cosmological Parameters

WUM reveals the inter-connectivity of primary cosmological parameters, showing that the gravitational parameter G , which can be directly measured, allows for the measurement of all other cosmological parameters that cannot be measured directly. We recommend that the CODATA Recommended Values of the Fundamental Physical Constants consider the measured value of the gravitational parameter and introduce the dimensionless quantity Q for the calculation of all cosmological parameters.

A Call for Collaboration and Further Development

WUM does not claim to explain all available cosmological data, as such a feat is impossible for any single manuscript. Nor does it present itself as a finished, all-encompassing theory. Instead, it should be further developed into a comprehensive theory by the entire physical community.

Recent astronomical discoveries and experimental results should be analyzed through the lens of WUM, establishing a new paradigm. Astronomers should design targeted experiments based on these analyses. Considering the recent discoveries by the James Webb Space Telescope (JWST), the successes of WUM, and 87 years of Dirac's proposals, it is time for a paradigm shift in Cosmology and Classical Physics.

A New Era for Astronomy, Cosmology, and Astrophysics

Astronomers have made significant progress in studying the Solar System, transforming it into an experimental laboratory for testing astrophysical theories. We are at the dawn of a new era in Astronomy, Cosmology, and Astrophysics. Young physicists should be at the forefront of this revolution, focusing their efforts on developing a new Cosmology and Classical Physics. I am very excited about the future of Physics and the discoveries that lie ahead.