

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

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## Abstract

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

- 1) **Dark galaxies** explained by the spinning of their Dark Matter Cores with the surface speed at equator less than the escape velocity. Their Rotational Fission is not happening. Extrasolar systems do not emerge;
- 2) **21-cm Emission** explained by the self-annihilation of Dark Matter particles XIONs ( $5.3 \mu eV$ );
- 3) **Sun-Earth-Moon Interaction** explained by the influence of the Sun's and the Moon's magnetic field on the electrical currents in the Geomagma (the 660-km layer), and, as a result, the Earth's daylength varies;
- 4) **Tunguska Event** explained by the huge atmospheric explosion of the Superbolide, which was a stable Dark Matter Bubble before entering the Earth's atmosphere.

## 1. Introduction

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

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

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

## 2. Dark Galaxies

### 2.1. Observations

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

Initially discovered in 2000, **VIRGOHI 21** was announced in 2005 as a good candidate to be a true dark Galaxy. R. Minchin, *et al.* in the article "21-cm Synthesis Observations of VIRGOHI 21 – a Possible Dark Galaxy in the Virgo Cluster" say: "*Many observations indicate that dark matter dominates the extra-galactic Universe, yet not dark structure of galactic proportions has ever been convincingly identified. Previously we have suggested that VIRGOHI 21, a 21-cm source we found in the Virgo Cluster, was a possible dark galaxy because of its broad line-width ( $\sim 200 \text{ km s}^{-1}$ ) 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, but lacking the massive interactor normally linked with such a feature. We have also used the Hubble Space Telescope to search for stars associated with the HI and find none*" [5].

The cloud is at the Virgo cluster's distance of 52 Mly. It is roughly 50 kly across, about half the diameter of the Milky Way (MW) galaxy's' starry disk. The strength of the 21-cm emission indicates that the cloud harbors  $2 \times 10^7 M_{\odot}$  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  $9 \times 10^{10} M_{\odot}$* " [5].

Based on HI survey, J-L. Xu, *et al.* 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 with a redshift of  $z=0.0083$ . This is the first time that an isolated dark galaxy has been detected in the nearby universe [6].

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

### 2.2. 21-cm Emission

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



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

According to M. Padovani, *et al.*, (2018) “*Small amounts of atomic hydrogen, detected as absorption dips in the 21 cm line spectrum, are a well-known characteristic of dark clouds. **The abundance of hydrogen atoms measured in the densest regions of molecular clouds can only be explained by the dissociation of H<sub>2</sub> by cosmic rays***” [9].

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

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

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

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

## 3. Formation of Macrostructures [1]

### 3.1. Multicomponent Dark Matter

Hypersphere World-Universe Model (WUM) proposes multicomponent DM system consisting of two couples of co-annihilating Dark Matter Particles (DMPs): a heavy Dark Matter Fermion (DMF) – DMF1 (1.3 TeV) and a light spin-0 boson – DIRAC (70 MeV) that is a dipole of Dirac's monopoles with charge  $\mu = e/2\alpha$  ( $e$  is an elementary charge and  $\alpha$  is a dimensionless Rydberg constant); a heavy fermion – DMF2 (9.6 GeV) and a light spin-0 boson – ELOP (340 keV) that is a dipole of preons with electrical charge  $e/3$ ; self-annihilating fermions DMF3 (3.7 keV), DMF4 (0.2 eV), and boson XION (5.3  $\mu eV$ ) that is an analog of Axion discussed in literature.

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

The reason for this multicomponent DM system was to explain:

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

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

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

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

### 3.2. Macroobject Shell Model

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

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

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

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

The calculated parameters of the shells show that:

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

### 3.3. Angular Momentum

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

In our opinion, there is only one mechanism that can provide angular momenta to Macroobjects (MOs) – **Rotational Fission (RF)** of overspinning (surface speed at equator exceeding escape velocity) Prime Objects. From the point of view of Fission model, the Prime object is transferring some of its rotational angular momentum to orbital and rotational momenta of satellites. It follows that **rotational momenta of prime objects should exceed orbital momenta of their satellites**.

In frames of WUM, Prime Objects are DM Cores of Superclusters, which must accumulate tremendous angular momenta before the Birth of the Luminous World. It follows that a long enough time period must elapse. We named this period “Dark Epoch” and developed a New Cosmology of the World [14]:

- WUM introduces Dark Epoch (spanning from the Beginning of the World 14.22 Byr ago for 0.45 Byr) when only DM MOs existed, and Luminous Epoch (ever since for 13.77 Byr) when Luminous MOs emerged due to RF of Superclusters' DM Cores and self-annihilation of DMPs;
- Main players of the World are Superclusters' DM Cores that accumulated tremendous rotational angular momenta during Dark Epoch and transferred it to DM Cores of Galaxies during their RF;
- The experimental observations of galaxies in the World show that most of them are disk galaxies. These results speak in favor of the developed RF mechanism;
- MW's DM Core was born 13.77 Byr ago as the result of RF of Virgo Supercluster's DM Core;
- DM Cores of ESS, planets and moons were born as the result of the repeating RFs of Galaxy's DM Cores in different times (4.57 Byr ago for Solar System (SS) in MW);
- MOs of the World form from the top (superclusters) down to galaxies, ESS, planets, and moons.

### 3.4. Formation of Macrostructures

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

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

In frames of the developed RF model, the following discoveries can be explained:

- Gravitational Birst of ODMC of Virgo Supercluster 13.77 Byr ago gave birth to Sgr A\* , the Core of MW;
- Gravitational Birst of ODMC of MW 13.77 Byr ago gave birth to the core of the eldest Methuselah star;
- Gravitational Birst of ODMC of MW 5 Myr ago gave birth to the binary system Cyg X-1 at the same time, moreover dark star is the rotating DM core made of DMF1 and DMF2 with the surface speed at equator less than the escape velocity. Both stars have Halos made of DMF3 particles (3.7 keV) emitting X-rays as the result of their self-annihilation.

### 3.5. WUM Explanation

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

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

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

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

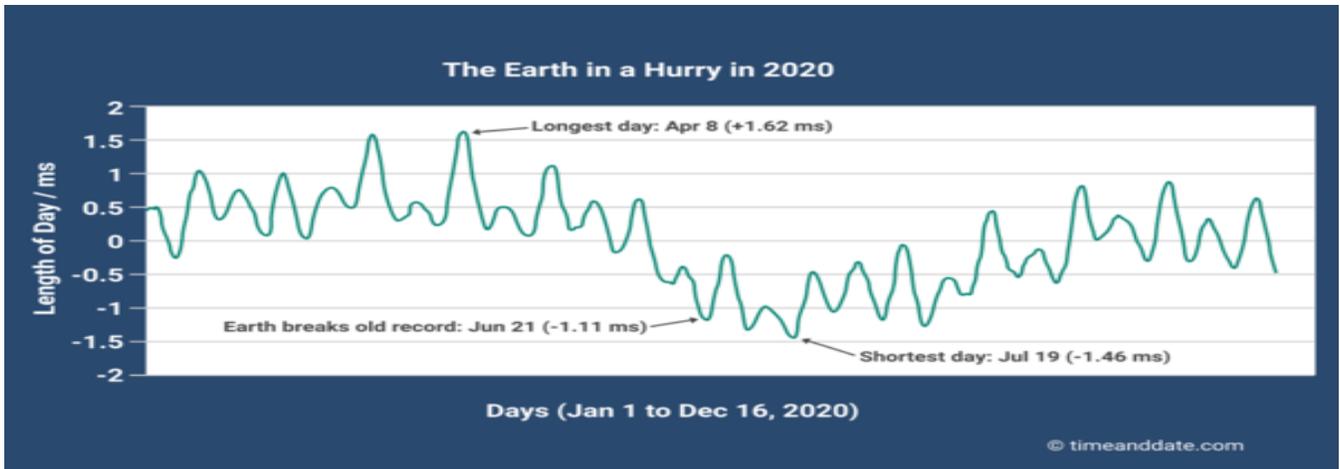
- "Yolk" – spinning liquid DM Core of galaxy with high viscosity composed of DMPs (DMF1, DMF2, and DMF3). "Yolk" contains 1/3 of the total galaxy Matter;
- "Albumen" – liquid Intragalactic Medium (IGM) with low viscosity made of DMF3 with dissolved other DMPs (DMF4 and XIONs). Weak interaction between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

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

## 4. Sun-Earth-Moon Interaction [17]

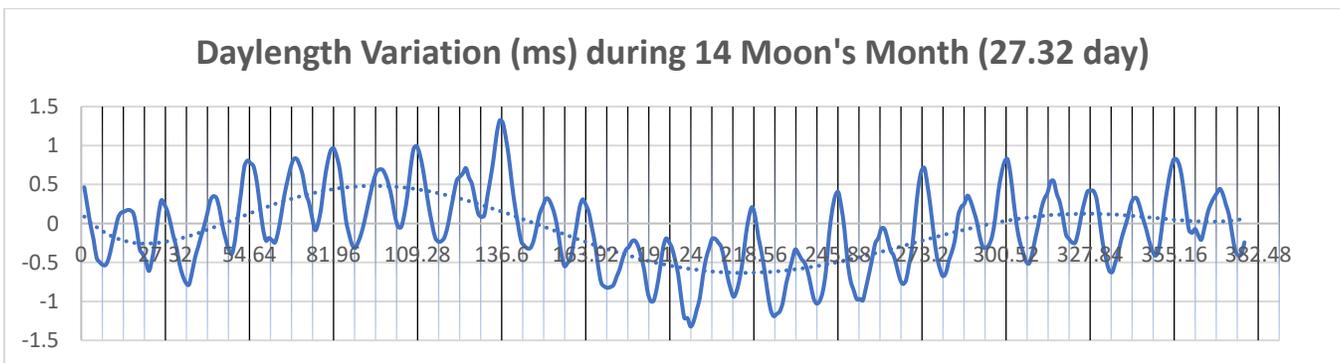
### 4.1. Earth-Moon Interaction

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



**Figure 2.** Variation of daylength throughout 2020. The length of day is shown as the difference in milliseconds (ms) between the Earth's rotation and 86,400 seconds. Adapted from [15].

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

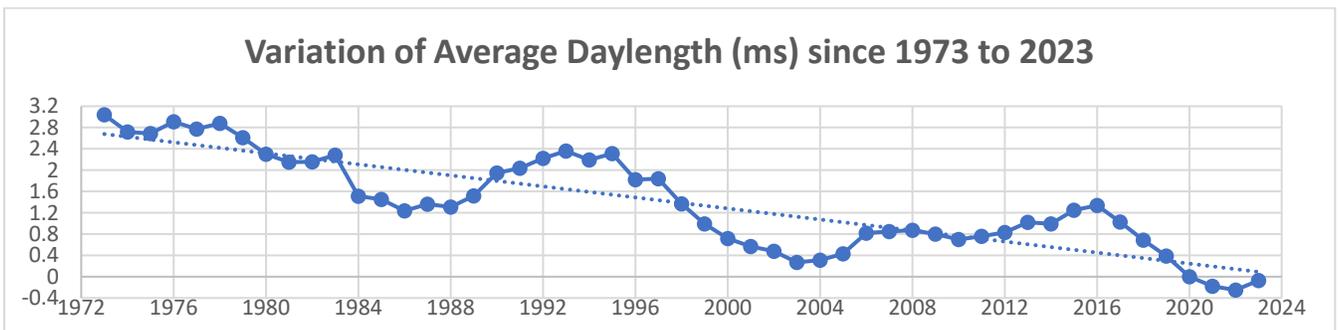


**Figure 3.** Variation of daylength around SI based 86400 s throughout 2023.

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

## 4.2. Sun-Earth Interaction

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



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

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

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

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

### 4.3. WUM Explanation

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

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

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

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

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

## 5. Tunguska Event [18]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

and a calculated minimum particles concentration is:

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

Considering the rest energy of DMF1:

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

we can calculate the minimum energy density of DM core:

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

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

Tunguska Superbolide (TSB) had the calculated maximum energy

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

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

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

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

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

### Summary:

- Tunguska Event explained by the huge atmospheric explosion of the Superbolide, which was a stable DM Macroobject before entering the Earth's atmosphere. It was a Bubble with the core made of the DM particles DMF1 (1.3 TeV) with a mass density of  $3.44 \text{ kg/m}^3$  that is not enough for the efficient self-annihilation. The introduced Weak interaction provides an integrity of the DM core, and the Super-Weak interaction provides the integrity of the Bubble itself. Ram pressure and the very high temperatures in the Bubble are the cause Superbolide exploded;
- Ecliptic comets were produced by Sun as a result of RF of the Sun's DM Core 4.57 Byr ago. Nearly isotropic comets were produced by Giant Planets with different directions of their rotational axes as a result of RF of their DM cores. All compositions of asteroids and comets were produced by self-annihilating DM cores.

## 6. Explained Problems [20]

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

- **Angular Momentum problem** in birth and subsequent evolution of Galaxies and ESS explained by Volcanic Rotational Fission of Overspinning DM Supercluster's Cores;
- **Hubble Tension** explained by observations of Galaxies, which belong to different Superclusters. The value of Hubble's parameter should be measured based on Cosmic Microwave Background Radiation only;
- **Missing Baryon problem**, related to the fact that the observed amount of baryonic matter did not match theoretical predictions, solved by the calculation of the concentration of Intergalactic plasma;
- **Fermi Bubbles** – two large structures in gamma-rays and X-rays above and below Galactic center – are stable clouds of DMPs (DMF1, DMF2, and DMF3) containing uniformly distributed DM Objects, in which DMPs self-annihilate and radiate X-rays and gamma rays;
- **Galaxies are ellipticals and spirals** due to an Explosive Rotational Fission of their Overspinning DM Cores;
- **Coronal Heating Problem** relates to a question of why the temperature of the Solar corona is millions of degrees higher than that of the photosphere. According to WUM, the origin of the Solar corona plasma is not coronal heating. Plasma particles (electrons, protons, multicharged ions) are so far apart that plasma temperature in the usual sense is not very meaningful. Plasma is the result of the self-annihilation of DMPs. The Solar corona made up of DMPs resembles a honeycomb filled with plasma;
- **Cores of Sun and Earth** rotate faster than their surfaces despite high viscosity of the internal medium. WUM explains the phenomenon through absorption of DMPs by Cores. DMPs supply not only additional mass ( $\propto \tau^{3/2}$ ), but also additional angular momentum ( $\propto \tau^2$ ). Cores irradiate products of self-annihilation, which carry away excessive angular momentum. Solar wind is the result of this mechanism;
- **Internal Heating of Gravitationally-Rounded Objects** in SS is explained by DMRs inside of all MOs fueled by DMPs. Internal Heating is due to DMPs self-annihilation;
- **Diversity of Gravitationally-Rounded Objects** in SS is explained by DMRs inside of MOs fueled by DMPs. All chemical elements, compositions, radiations are produced by MOs themselves as the result of DMPs self-annihilation in their different DM cores;
- **Plutonium-244** with half-life of 80 million years exists in Nature. It is not produced by the nuclear fuel cycle, because it needs very high neutron flux environments. Any Pu-244 present in the Earth's crust should have decayed by now. In WUM, all chemical products of the Earth including isotopes K-40, U-238, Th-232, and Pu-244, are produced within the Earth as the result of DMF1 self-annihilation. They arrive in the Crust of the Earth due to convection currents in the mantle carrying heat and isotopes from the interior to the planet's surface;
- **Expanding Earth** hypothesis asserts that the position and relative movement of continents is at least partially due to the volume of Earth increasing. In WUM, the Earth's DM core absorbs new DMPs, and its size is increasing in time  $\propto \tau^{1/2}$ . Hence, there is an expansion of DM core, and its surface (the Upper mantle with Crust) is stretching. Due to DMPs self-annihilation, new chemical elements are created inside of the Upper mantle with Crust. As the result, the relative movement of continents is happening;
- **Faint young Sun paradox** describes the apparent contradiction between observations of liquid water early in Earth's history and the astrophysical expectation that the Sun's output would be only 70% as intense during that epoch as it is during the modern epoch. In WUM, all MOs of the World were fainter in the past. As their DM cores absorb new DMPs, the sizes of MOs and thus their luminosity are increasing

in time  $\propto \tau$ . Considering the age of the World  $\cong 14.2$  Byr and the age of SS  $\cong 4.6$  Byr, it is easy to find that the young Sun's output was only 67.6% of what it is today;

- **Matter-Antimatter Asymmetry problem.** Ordinary Matter is a byproduct of DMPs self-annihilation. This problem does not arise, since antimatter does not get created by DMPs self-annihilation;
- **Black-body spectrum of Microwave Background Radiation** is due to thermodynamic equilibrium of photons with Intergalactic plasma;
- **Unidentified Infrared Discrete Emission Bands** with peaks 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7  $\mu\text{m}$  explained by the self-annihilation of DM particles DMF4 (0.2 eV);
- **Solar Corona, Geocorona and Planetary Coronas** made up of DMPs resemble honeycombs filled with plasma particles (electrons, protons, multicharged ions), which are the result of DMPs self-annihilation;
- **Lightning Initiation problem** and **Terrestrial Gamma-Ray Flashes** are explained by the self-annihilation of DMPs in Geocorona;
- **Ball Lightnings** are objects that have cores made up of DMPs surrounded by the electron-positron plasma shells contaminated by chemical elements of soil and air as the result of Terrestrial Gamma-Ray Flash strikes of the ground. WUM predicts a **new phenomenon** – a generation of BLs according to the proposed model of them. Once we master the creation of BLs in a controlled environment, we can concentrate our efforts on harvesting that energy from a practically infinite Source – the Medium of the World with DMPs.

## 7. Conclusion

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

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

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