Principal Role of Angular Momentum in Cosmology

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Abstract

According to "Evolution Encyclopedia" (The Origin of the Solar System), "*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 solar system origin are to be accepted. Scientists cannot account for this puzzling situation: less than one percent of the mass of the solar system is in the planets, while a staggering 98 percent of its angular momentum is in them. It simply does not fit into any of the cosmologies. 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**"* [1].

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 Hypersphere World-Universe Model (WUM) is only cosmological model in existence that is consistent with the Law of Conservation of Angular Momentum [2]. In the present paper, we discuss Angular Momenta of Solar System, Milky Way galaxy, and Superclusters in frames of WUM.

1. Introduction

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

- How did Galaxies and Extrasolar systems get their substantial orbital and rotational angular momenta;
- How did Milky Way (MW) galaxy give birth to different Extrasolar systems in different times;
- The beginning of MW was about 13.77 Byr ago . 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 (named Methuselah) is nearly as old as the universe itself. How did it happen?
- The beginning of the Solar System (SS) was 4.57 Byr ago. What is the origin of SS rotational and orbital angular momenta? We must discuss the Beginning of SS;
- P. Wang, *et al.* 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*** [3]. We must discuss the Beginning of the World.

In our opinion, there is only one mechanism that can provide angular momenta to Macroobjects – **Rotational Fission** of overspinning 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** [2].

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" and developed a New Cosmology of the World [2]:

- 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, 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 that accumulated tremendous rotational angular momenta during Dark Epoch and transferred it to DM Cores of Galaxies during their Rotational Fission;
- The experimental observations of galaxies in the World show that most of them are disk galaxies [4]. These results speak in favor of the developed Rotational Fission mechanism;
- MW's DM Core was born 13.77 Byr ago as the result of Rotational Fission of Virgo Supercluster's DM Core;
- DM Cores of Extrasolar systems, planets and moons were born as the result of the repeating Rotational Fissions of MW's DM Core in different times (4.57 Byr ago for SS);
- Macrostructures of the World form from the top (superclusters) down to galaxies, extrasolar systems, planets, and moons.

The present article discusses an Explosive Volcanic Rotational Fission (VRF) model of creation and evolution of Macrostructures of the World (Superclusters, Galaxies, Extrasolar Systems), based on DM Overspinning (surface speed at equator exceeding escape velocity) Cores of the World's Macroobjects.

2. Explosive Volcanic Rotational Fission Model

2.1. 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 the elementary charge); a heavy fermion – DMF2 (9.6 GeV) and a light spin-0 boson – ELOP (340 keV) that is a dipole of preons with electrical charge e/3; self-annihilating fermions DMF3 (3.7 keV) and DMF4 (0.2 eV). The reason for this multicomponent DM system was to explain the diversity of DM Cores of MOs of the World (superclusters, galaxies, and extrasolar systems), which are Fermion Compact Objects in our Model [5].

WUM postulates that rest energies of DMFs and bosons are proportional to a basic energy unit: $E_0 = hc/a$ (h is Planck constant, c is an electrodynamic constant, and a is a basic size unit) multiplied by different exponents of α (dimensionless Rydberg constant) and can be expressed with following formulae:

DMF1 (fermion): $E_{DMF1} = \alpha^{-2}E_0 = 1.3149950\ TeV$
DMF2 (fermion): $E_{DMF2} = \alpha^{-1}E_0 = 9.5959823\ GeV$
DIRAC (boson): $E_{DIRAC} = \alpha^{0}E_0 = 70.025267\ MeV$
ELOP (boson): $E_{ELOP} = 2/3\alpha^{1}E_0 = 340.66606\ keV$
DMF3 (fermion): $E_{DMF3} = \alpha^{2}E_0 = 3.7289402\ keV$
DMF4 (fermion): $E_{DMF4} = \alpha^{4}E_0 = 0.19857111\ eV$

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.

2.2. 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 (see Section 3.2) 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	Fermion Mass m_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 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.

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 [6]. It is worth noting that there are no black holes in WUM.

In WUM, Cores of all MOs possess the following properties [7]:

- 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;
- 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 (OCs). The detonation process does not destroy OCs; 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 OC 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 OC 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 GB, the OCs lose a small fraction of their mass and a large part of their rotational angular momentum;
- After GB, DM Cores of Prime Objects (superclusters, galaxies, stars, and planets) 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, respectively) 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 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.

3. Formation of Macrostructures

3.1. 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 R_W (see Section 3.2). As the result of the weak interaction, clumps of DMF1 will arise. 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 (0.45 Byr).

The process described above is the formation of the DM Core of Superclusters [8]. 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 (see Section 3.3). We estimate the number of Supercluster Cores at the end of Dark Epoch to be around $\sim 10^3$ [8]. It is unlikely that all of them gave birth to Luminous Superclusters at the same cosmological time being far away from each other.

3.2. Weak Interaction

Widely discussed models for nonbaryonic DM are based on the Cold DM hypothesis, and corresponding particles are commonly assumed to be WIMPs, *which interact via gravity and any other force (or forces), potentially not part of the standard model itself, which is as weak as or weaker than the weak nuclear force, but also, non-vanishing in its strength* [9]. It follows that a new weak force needs to exist, providing interaction between DMPs.

According to WUM, strength of gravity is characterized by the gravitational parameter G [8]:

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

where $G_0 = \frac{a^2c^4}{8\pi hc}$ is an extrapolated value of G at the Beginning of the World (*Q=1*). A dimensionless time-varying quantity Q, which is a measure of the Size R and Age A_τ of the World and is, in fact, the Dirac Large Number (t_0 is a basic time unit: $t_0 = a/c = 5.9059662 \times 10^{-23}\ s$)

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

in present epoch equals to: $Q = 0.759972 \times 10^{40}$. The range of the gravity equals to the size of the World R:

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

In WUM, a weak interaction is characterized by the parameter G_W :

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

which is about 30 orders of magnitude greater than G. The range of the weak interaction R_W in the present Epoch equals to:

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

that is much greater than the range of the weak nuclear force. Calculated concentration of DMF4 particles n_{DMF4} in the largest shell of Superclusters: $n_{DMF4} \cong 4.2 \times 10^{15}\ m^{-3}$ (**see Table 1**) shows that a distance

between particles is around $\sim 10^{-5}\, m$, which is much smaller than R_W . Thus, the introduced weak interaction between DMPs will provide integrity of all DM shells. In our view, weak interaction between particles DMF3 provides integrity of Fermi Bubbles [7].

3.3. Rotational Fission

According to WUM, a rotational angular momentum of overspinning (surface speed at equator exceeding escape velocity) object before rotational fission is [10]:

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

where 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 τ^2.

Virgo Supercluster (VS) is a mass concentration of galaxies containing MW. At least 100 galaxy groups and clusters are located within its diameter of 110 Mly. Considering parameters of DMF4 shell (see **Table 1**), we calculate the rotational angular momentum L_{rot}^{VSC} of VS Core before rotational fission:

$$L_{rot}^{VSC} = 3.7 \times 10^{77} J\, s$$

MW is gravitationally bounded with VS [11]. Let us compare L_{rot}^{VSC} with an orbital momentum of MW L_{orb}^{MW} calculated based on the distance of 65 Mly from VS Core and orbital speed of about 400 km/s [12]:

$$L_{orb}^{MW} = 2.5 \times 10^{71}\, J\, s$$

It means that as the result of rotational fission of VS Core, approximately $\sim 10^6$ galaxies like MW could be generated at the same time. Considering that density of galaxies in the VS falls off with the square of the distance from its center and the location of MW on the outskirts of the VS [13], the actual number of created galaxies could be much larger.

Analogous calculations for MW Core based on parameters of DMF3 shell (see **Table 1**) produce the following value of rotational angular momentum L_{rot}^{MWC} [10]:

$$L_{rot}^{MWC} = 2.4 \times 10^{60}\, J\, s$$

which far exceeds the orbital momentum of the Solar System L_{orb}^{SS} calculated based on the distance from the galactic center of 26.4 kly and orbital speed of about 220 km/s :

$$L_{orb}^{SS} = 1.1 \times 10^{56}\, J\, s$$

As the result of rotational fission of MW Core 13.77 Gyr ago, approximately $\sim 10^4$ Extrasolar systems like SS could be created at the same time. Considering that MW has grown inside out (in the present Epoch, most old stars can be found in the middle, more recently formed ones on the outskirts [14]), the number of generated Extrasolar systems could be much larger. Extrasolar system Cores can give birth to planetary cores, which in turn can generate cores of moons by the same Rotational Fission mechanism. Luminous Epoch is the result of Explosive VRF of DM Cores of Superclusters and self-annihilation of DMPs.

To summarize:

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

4. 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} $M_{\odot}$ [15]. 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 250 Mly.

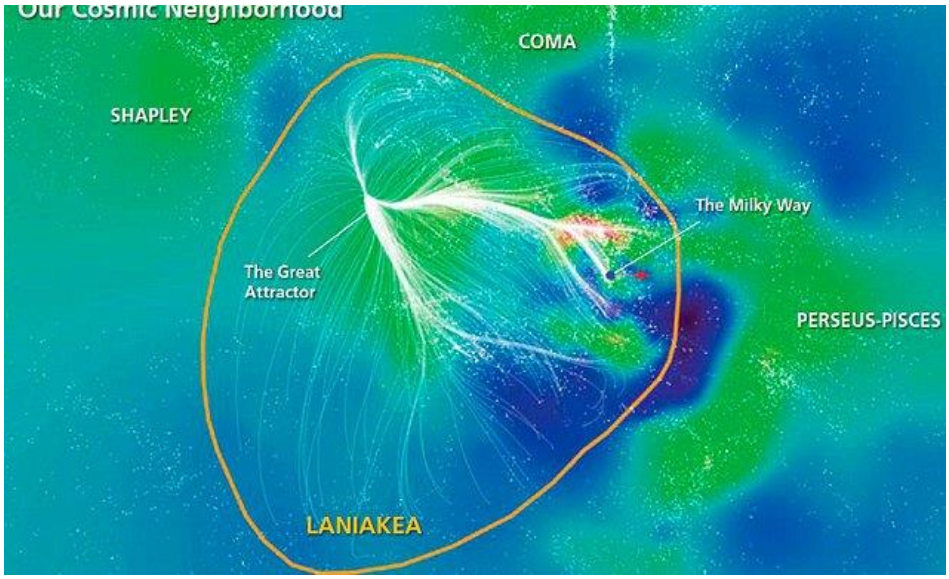

Figure 1. Laniakea Supercluster. Adapted from [16].

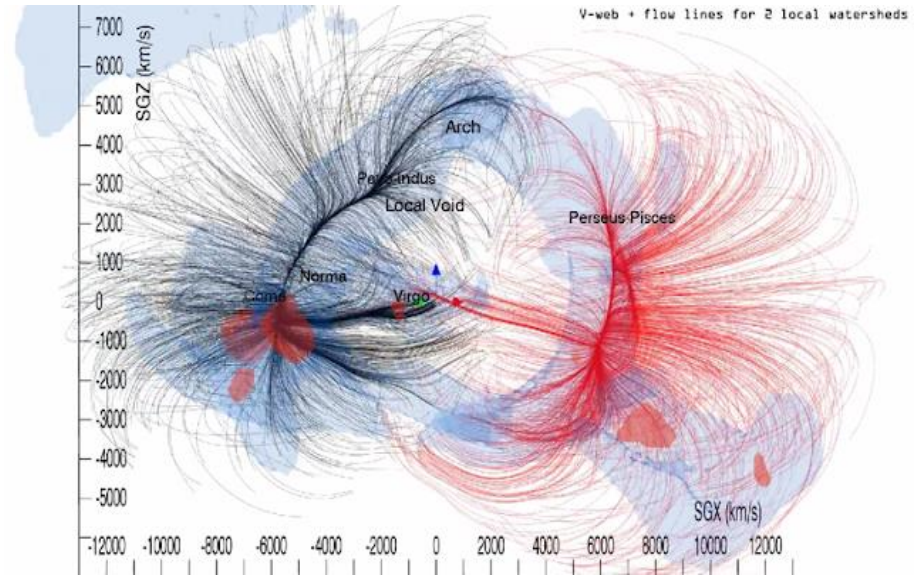

Figure 2. A representation of structure and flows due to mass within 6,000 km s−1 (~80 Mpc). Surfaces of red and blue respectively represent outer contours of clusters and filaments as defined by the local eigenvalues of the velocity shear tensor determined from the Wiener Filter analysis. Flow threads originating in our basin of attraction that terminate near Norma Cluster are in black and adjacent flow threads that terminate at the relative attractor near Perseus Cluster are in red. Arch and extended Antlia Wall structures bridge between the two attraction basins. Adapted from [16].

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 [17]. 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*" [18]. These ratios are one of the **main arguments in favor of presence of large amounts of Dark Matter in the World and validate the developed Model of Superclusters' Macrostructure.**

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 ($\gtrsim 10^3$).

According to R. B. Tully, *et al.*, "*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*" [16].

P. Wang, *et al.* 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***" [3].

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 approximately 1/15th the radius of the observable universe, is twice the size of the striking 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****. The discovery of the Giant Arc adds to the number of structures on scales larger than those thought to be "smooth", and therefore pushes the boundary size for the Cosmological Principle. The growing number of large-scale structures over the size limit of what is considered theoretically viable is becoming harder to ignore. According to cosmologists, the current theoretical limit is calculated to be 1.2 billion light years, which makes the Giant Arc almost three times larger.* ***Can the standard model of cosmology account for these huge structures in the Universe as just rare flukes or is there more to it than that?"*** [19].

B. Carr, *et al.* "*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"* [20].

WUM. These latest observations of the World 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;
- The calculated maximum mass of the supercluster DM Core of 2.1×10^{19} solar mass (see **Table 1**) is in good agreement with the values discussed by L. Bliss [15] and B. Carr, F. Kühnel and L. Visinelli [20]. 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 Gyr ago, when the Laniakea Supercluster emerged, the estimated number of DM Supercluster Cores in the World was around $\sim 10^3$ [21]. 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** and **Figure 2**). Big Bang never happened.

5. Milky Way Center

MW is a barred spiral galaxy with an estimated visible diameter of $100 - 200\ kly$. MW is a part of the Local Group of galaxies that form part of the Virgo Supercluster, which is itself a component of LSC. It is estimated to contain 100–400 billion stars. 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: $(4.1 \pm 0.6) \times 10^6\ M_\odot$ [22].

Several teams of researchers have attempted to image Sgr A* in the radio spectrum using very-long-baseline interferometry. The current highest-resolution (approximately 30 μas) measurement, made at a wavelength of 1.3 mm, indicated an overall angular size for the source of $50\ \mu as$ [23]. At a distance of 26.673 kly this yields a diameter of $6.337 \times 10^{10}\ m$.

E. A. C. Mills in her "Journey to the Center of the Galaxy: Following the gas to understand past and future activity in galaxy nuclei" wrote [24]: *"The **young stars in the central lightyear**, the innermost of whose orbits are famously used to determine parameters of central supermassive black hole, are suggested to have formed in-situ in one of the most extreme environments imaginable: in an incredibly dense gas disk a fraction of a light year from the black hole. Even allowing for recent activity in the past few hundred years which we can detect from the X-ray light of these outbursts reflecting off of clouds a few hundred light years from the black hole… **our black hole is no AGN**"* (Active Galactic Nucleus).

On 2015, NASA reported observing an X-ray flare 400 times brighter than usual, a record-breaker, from Sgr A*. The unusual event may have been caused by the breaking apart of an asteroid falling into Supermassive Black Hole or by entanglement of magnetic field lines within gas flowing into Sgr A* [25].

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 by the orbiting Chandra X-ray observatory, depicts billions of stars in the center of MW. The author D. Wang of the University of Massachusetts Amherst said: "*What we see in the picture is a violent or energetic ecosystem in our galaxy's downtown"* [25].

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"* [26]. R. Genzel and A. Ghez were awarded the 2020 Nobel Prize in Physics for their **discovery that Sgr A* is a supermassive compact object**, for which supermassive Black Hole was the only accepted explanation. In our view, it is the DM Core of MW.

In frames of **WUM** (see **Table 1**):

- The calculated value of the radius of the Electron-Positron shell $2.9 \times 10^{10}\ m$ is in excellent agreement with the experimentally measured value of the radio source $3 \times 10^{10}\ m$ [22];
- 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 $8.5 \times 10^{36}\ kg$ [21];
- 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 can be explained by the detonation of DMF3 particles (3.7 keV) and their self-annihilation [27];
- The excess of gamma-ray emission with energy about 10 GeV reported by D. Hooper and L. Goodenough in the Galactic Center [28] can be explained by DMF2 particles (9.6 GeV) self-annihilation;
- DM Fermi Bubbles can be explained based on DMF1, DMF2, and DMF3 particles [8].

The oldest known star HD 140283 (Methuselah star) is a subgiant star about 190 light years away from Earth for which a reliable age has been determined [29]. H. E. Bond, *et al.* found its age to be $14.46 \pm 0.8\ Byr$ that does not conflict with the Age of the Universe, $13.77 \pm 0.06\ Byr$, based on the microwave background radiation and Hubble constant [30]. It means that this star must have formed between 13.66 and 13.83 Byr, an amount of time that is too short for formation of the second generation of stars according to prevailing theories. In our Model, this discovery can be explained by generation of HD 140283 by overspinning Core of MW 13.77 Byr.

In frames of the developed Rotational Fission model, it is easy to explain hyper-runaway stars unbound from the MW with speeds of up to $\sim 700\ km/s$ [31]: they were launched by overspinning DM Core of the Large Magellanic Cloud with the speed higher than the escape velocity.

S. E. Koposov, *et al.* 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 ~ 9 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 ~ 1800 km/s , and travelled for 4.8 Myr to its current location. So far, this is the only hyper-velocity star confidently associated with the Galactic Centre [32]. In frames of the developed Model, this discovery can be explained by Gravitational Burst (GB) 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 the Core.

C. J. Clarke, *et al.* observed CI Tau, a young 2 million year old star. CI Tau is located about 500 light years away in a highly-productive stellar "*nursery*" region of the galaxy. They discovered that the Extrasolar system contains four gas giant planets that are only 2 million years old [33], an amount of time that is too short for formation of gas giants according to the prevailing theories. In frames of the developed Rotational Fission model, this discovery can be explained by GB of the MW Core 2 million years ago, which gave birth to the CI Tau system with all the planets generated at the same time.

6. Solar System

6.1. Facts about Planets and Moons

According to "Evolution Encyclopedia" (The Origin of the Solar System), there are the following facts that do not fit into any evolutionary theory of how our solar system came into existence [1]:

- *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! There is no known mechanical process which could accomplish this transfer of momentum from the sun to its planets;*
- *Jupiter itself has 60 percent of the planetary angular motion. Evolutionary theory cannot account for this. This strange distribution was the primary cause of the downfall of the nebular hypothesis;*
- *Both Uranus and Venus rotate backwards to that of all the other planets. Seven of the nine planets rotate directly forward, in relation to their orbit around the sun. 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. Theories of cosmology cannot explain backwards-orbiting moons;*
- *Consider Triton, the inner of Neptune's moons, which, with a diameter of 4,830 km, is nearly twice the mass of our moon, yet it revolves backwards every six days, has a nearly circular orbit,—and is only 354,046 km from its planet! I. Asimov has tried to explain it with a theory that it "was thrown away from that planet by some cosmic collision or other accident" and, at a later time, flew back and was recaptured "by similar accident"! The same explanation is used for all other backward-orbiting moons. Evolutionists try to explain everything in the universe as nothing more than a series of fortunate accidents. If that is the explanation for Triton's retrograde motion, how about the other one-third of the moons in our solar system, which rotate the same way?* ***How many such "accidents" may the evolutionists be permitted to invoke to prop up theories already tottering under the weight of their own unproved assumptions?***
- *There are such striking differences between planets and planets, planets and moons, moons and moons,—that the experts can produce no explanation that can explain them. If they all came from the same gas clouds, they should all be alike! But some are relatively smooth, others extremely mountainous, still others have volcanoes, and yet others are covered with a variety of peculiar chemical atmospheres*.

6.2. Solar System in WUM

In our opinion, the explanations of all these Facts and SS Mysteries (Venus spin backwards; Uranus tilted sideways; Moon creation; Mars hit by a giant cosmic lightning bolt) [5] based on the Impact theory are unrealistic and were proposed from hopelessness in frames of the Standard model. To the best of our knowledge, in literature it was never discussed and explained a real picture of SS objects' angular momenta (see **Figure 3, Table 2, and Table 3**). Why do Sun and all Objects have so different values and orientations of their motion being created from the same nebula with a **certain amount of angular momentum** [5]?

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. In actual usage, the terms galactic plane and galactic poles usually refer specifically to the plane and poles of MW, in which planet Earth is located.

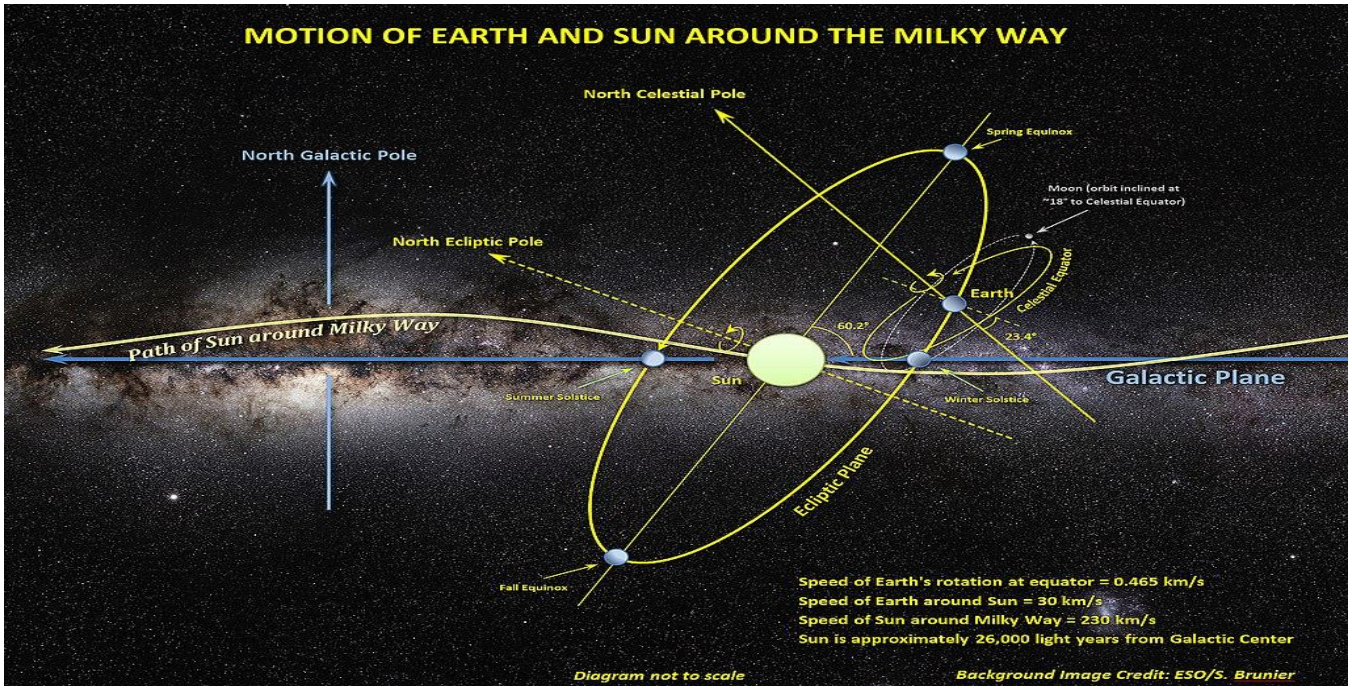

Figure 3. Orientation of the motion of SS Objects. Adapted from [34].

Table 2. Orientation of Angular momentum of gravitationally rounded objects of SS. Adapted from [35].

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

Let us consider rotational and orbital angular momentum of all gravitationally-rounded objects in SS, from Mimas, a small moon of Saturn ($3.75 \times 10^{19}\ kg$), to the Sun itself ($2 \times 10^{30}\ kg$). Their angular momenta are presented in **Table 3.** From the point of view of 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 3** 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.

SS was born 4.57 Byr ago as the result of the repeating Gravitational burst of MW's Core. At that time, the rotational angular momentum of the Core L_{rot}^{MWC} was much larger than L_{orb}^{SS} (see Section 3.3). Considering that Jupiter's orbital momentum is about 60% of the total angular momentum of SS L_{tot}^{SS}, we obtain:

$$L_{tot}^{SS} \cong 3.2 \times 10^{43}\ J\ s$$

Let us calculate parameters of the Sun's Core necessary to provide this angular momentum. Considering mass of the Sun $M_{Sun} = 2 \times 10^{30}\ kg$ and radius $R_{Sun} = 7 \times 10^{8}\ m$, we obtain [2]:

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

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

Table 3. Value of Rotational and Orbital angular momentum of gravitationally-rounded objects in SS [2].

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

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 $\rho_{max} = 1.5 \times 10^5\ kg/m^3$ and $\rho_{min} = 2 \times 10^4\ kg/m^3$. It produces all Sun's energy;

- Radiative zone from the Core to about 70% of the solar radius with density $\rho_{max} = 2 \times 10^4\ kg/m^3$ and $\rho_{min} = 2 \times 10^2\ kg/m^3$ in which convection does not occur and energy transfer occurs by radiation;
- Core and Radiative zone contain practically all Sun's mass [11].

In our opinion, the Sun has an Inner Core (Nucleus made up of DMF1) whose radius is 20–25% of the solar radius, and an Outer Core – the Radiative zone. We then calculate the Solar Core rotational angular momentum L_{rot}^{SC} :

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

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

Let us follow the same procedure for Earth – Moon pair. Considering the mass of Earth $M_E = 6 \times 10^{24} kg$ and radius $R_E = 6.4 \times 10^6 m$, we calculate $L_{rot}^{Earth} = 6.6 \times 10^{34}\ J\ s$ that is 2.3 times larger than a Moon's orbital momentum $L_{orb}^{Moon} = 2.9 \times 10^{34}$ J s (see **Table 3**).

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 $\rho_{max} = 1.3 \times 10^4\ kg/m^3$ 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 $\rho_{min} = 4.4 \times 10^3\ kg/m^3$;
- Inner core, outer core, and lower mantle contain practically all of the Earth's mass [36].

Very little is known about the lower mantle apart from that it appears to be relatively seismically homogeneous. Outer core – lower mantle boundary has a sharp drop of density $(9.9 \rightarrow 5.6) \times 10^3\ kg/m^3$ [36]. 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 DMF1 self-annihilation. Considering the Earth's core (EC) with radius $R_{core}^{Earth} = 5.7 \times 10^6\ m$, the rotational angular momentum equals to:

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

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 independent objects that happened to be bounded together by gravity.

6.3. WUM Explanations

To be consistent with the Law of Conservation of Angular Momentum, we developed a New Cosmology (see Section 2). Big angle between Galactic Pole and Ecliptic Pole is due to the random Volcanic Rotational Fission of MW Galaxy DM Core creating many ESS DM cores at the same time, so that the direction of the sum of all ESS angular momentum coincides with the direction of galactic poles. The same explanation is valid for the Sun's DM Core and DM cores of the planets with moons considering that they were created at the same time 4.57 Byr ago.

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**.

According to the developed model of MOs, all chemical elements, compositions, substances, rocks are "homemade" and produced by MOs themselves as the result of DMPs self-annihilation. The diversity of all gravitationally-rounded objects of SS is explained by their distance from the Sun that provides some energy

to planets and moons, and the differences in their DM Cores (mass, size, composition). DM Reactors inside of gravitationally-rounded objects in hydrostatic equilibrium provide sufficient energy for all geological processes on planets and moons.

7. Conclusion

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!

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