# Great Structures in World–Universe Cosmology:
## From Observable World to Extrasolar Systems

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## Abstract

World–Universe Cosmology (WUC) describes the World as a finite, boundless three-dimensional Hypersphere forming the surface of an expanding four-dimensional Nucleus embedded in the Eternal Universe. The Observable World is identified with the Hubble Bubble. Its large-scale structure is described as a Patchwork Quilt of Luminous Superclusters formed in different regions and at different cosmological times.

This paper develops a hierarchy of Great Structures within the Observable World, from the Hubble Bubble and Luminous Superclusters through Galaxies and Globular Clusters to Extrasolar Systems.

The hierarchy is investigated using Surface Tension, characteristic Compton lengths of Universe-Created Particles (UCPs), and the Weak Interaction proposed in WUC. Particular attention is given to the dependence of structural scales on the evolving World Parameter (Q).

Building on earlier WUC studies of Cosmic Bubbles, Macroobjects, and the Solar System, the analysis applies the model's fundamental physical principles to structures of different scales.

The objective is to present a coherent physical and mathematical description of Great Structures within WUC, derive quantitative relationships, and identify observational tests of the proposed mechanisms.

# 1. Foundations of World–Universe Cosmology

## 1.1. Fundamental Assumptions

World–Universe Cosmology is based on four principal assumptions.

### 1. Four-Spatial Structure of the World

In WUC, the World is a finite, boundless three-dimensional Hypersphere forming the surface of a four-dimensional Nucleus. The Nucleus expands along the fourth spatial dimension at the fundamental speed (c), so the three-dimensional World is curved in the fourth spatial dimension.

### 2. Continuous Creation of Matter

The Eternal Universe continuously generates Universe-Created Matter (UCM) within the expanding four-dimensional Nucleus through the formation of Universe-Created Particles (UCPs). Within WUC, Ordinary Particles are produced through processes involving UCP pair annihilation.

### 3. Fundamental Role of the Cosmic Medium

The Cosmic Medium (CM) is an active physical component of the World in WUC. It participates in gravitation and in the formation and evolution of Macroobjects.

### 4. Fundamental Physical Parameters

The principal physical characteristics of the World are expressed through the following quantities:

- The Universe Constant ($K_U$), which is fixed.
- The fundamental Surface Tension ($\sigma_0$) of Cosmic Bubbles.

- The Angular Momentum flux density ($J_h$), directed from the four-dimensional Nucleus into the three-dimensional World. WUC proposes the fundamental relationship

$$\sigma_0 = J_h = \frac{h}{a^2 t_0}$$

where ($a$) is the fundamental length and ($t_0 = a/c$) is the fundamental time scale. The fundamental rest-energy scale and Planck's constant are expressed through

$$E_0 = \sigma_0 a^2 \qquad h = \sigma_0 a^2 t_0$$

- The World Parameter (Q), which evolves with cosmological time and characterizes the size and age of the World.

The fixed Universe Constant and evolving World Parameter, together with small integers and geometrical constants, determine the proposed scaling relations for microscopic and macroscopic structures.

# 1.2. Principal Physical Concepts

## Beginning and Expansion of the World

According to WUC, the World originated through a fluctuation in the Eternal Universe, giving rise to a four-dimensional Nucleus. Its finite, boundless three-dimensional surface constitutes the World.

The radius (R) of the Nucleus increases with cosmological time ($\tau$):

$$\frac{dR}{d\tau} = c$$

The dimensionless World Parameter is

$$Q = R/a$$

where ($a$) is the fundamental length

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

The expansion of the Nucleus stretches its three-dimensional surface without introducing a preferred center within the World. This geometry supplies the physical description of cosmic expansion in WUC.

## Creation of Universe-Created Matter

The Eternal Universe continuously creates UCM within the expanding four-dimensional Nucleus.

WUC assumes that UCPs are generated homogeneously throughout the Hypersphere World, contributing to the continuing evolution of its material content.

The expansion of the Nucleus also determines the direction of cosmological time.

## Content of the World

WUC distinguishes between the Cosmic Medium and Macroobjects.

The total energy density of the World is proposed to equal its critical energy density throughout cosmological evolution. The Cosmic Medium accounts for two-thirds of this density, while Macroobjects account for the remaining one-third.

UCPs constitute the dominant proposed component of the material content of the World (92.8%), while Ordinary Particles form a smaller component (7.2%).

### Rotational Fission and the Origin of Macroobjects

Within WUC, the formation of Luminous Macroobjects is associated with Rotational Fission of Superclusters' overspinning (surface speed at equator exceeding escape velocity) UCM Cores. Prime Objects accumulate angular momentum during the Dark Epoch. At critical stages of their evolution, their Cores are proposed to undergo Rotational Fission, transferring angular momentum to newly formed objects.

The Dark Epoch precedes the appearance of Luminous Macroobjects. The Luminous Epoch begins with the formation of such objects and continues to the present.

### Macroobject Shell Model

Gravitationally rounded Macroobjects possess UCM Cores surrounded by shells containing UCPs and Ordinary Particles.

Within WUC, the proposed Weak Interaction among these components contributes to the formation, integrity, and evolution of the shells.

### UCP Annihilation Reactors (UARs)

UCM Cores are proposed to operate as UCP Annihilation Reactors, continuously supplied with Universe-Created Particles.

Particle annihilation and associated processes within these cores contribute to internal heating, radiation, and the generation of Ordinary Matter.

### Hierarchical Formation of Macroobjects

Superclusters occupy a fundamental position in the proposed hierarchy of the Observable World.

WUC describes the large-scale distribution of Luminous Matter as a Patchwork Quilt of more than ($10^3$) Luminous Superclusters that emerged at different cosmological times and in different regions.

Macroobjects develop hierarchically, from Superclusters to Galaxies, Extrasolar Systems, planets, moons, and smaller structures.

Their formation and evolution are continuing processes.

## 1.3. Observational Connections

WUC relates its principal assumptions to several astronomical observations:

1. Microwave Background Radiation, Intergalactic Plasma, and Far-Infrared Background Radiation provide observational phenomena against which the proposed properties of the Cosmic Medium can be tested.
2. Laniakea and neighboring Superclusters illustrate the complex organization of large-scale cosmic structures.
3. The orbital angular momentum of galaxies within larger structures is considered in connection with the proposed Rotational Fission mechanism.
4. Dynamically inferred high mass-to-light ratios of Superclusters motivate tests of the substantial UCM components proposed by WUC.
5. Observations of galaxies at high redshift provide constraints on the formation and evolution of early Luminous Macroobjects.

These observations provide quantitative constraints for evaluating the predictions of WUC.

The principal foundations of the model are the **Cosmic Medium, Universe-Created Matter, and Angular Momentum**.

## 1.4. Cosmic Medium of the World

The Cosmic Medium occupies a central position in World–Universe Cosmology.

Within WUC, the Cosmic Medium is a physical Matter-filled Medium whose UCM component originates through the continuing generation of UCPs and whose Ordinary-Matter component arises subsequently through processes involving UCPs.

The Cosmic Medium emerges when the first ensemble of UCPs appears at cosmological time:

$$\tau_{CM}=t_0K_U^{-2} \sim 1.109 \times 10^{-18}\ s$$

with the radius of the Nucleus:

$$R_{CM}=aK_U^{-2} \sim 3.325 \times 10^{-10}\ m$$

From this stage onward, the physical properties of the Cosmic Medium can be characterized through quantities such as its Impedance, Gravitomagnetic parameter, and Energy Density.

The Cosmic Medium is homogeneous and isotropic. Its physical properties provide the common background within which Matter interacts and Macroobjects subsequently form and evolve.

In WUC, the laws of Classical Physics describe Matter and the physical Medium constituted by Matter.

The Cosmic Medium is treated as an active material component with definite physical properties.

Intergalactic regions with low concentrations of Luminous Matter are regarded as regions in which the Cosmic Medium is especially prominent.

Microwave Background Radiation is considered part of the Medium and provides an observationally accessible reference frame.

Within WUC, the Cosmic Medium is fundamental to the physical description of Time, Space, and Gravitation.

The Hubble parameter is related to cosmological time by

$$H=\tau^{-1}$$

The gravitational parameter G is connected with the Cosmic Medium energy density.

WUC describes gravitation as a manifestation of the Cosmic Medium. Its proposed microscopic mechanism involves XIONs in a Le Sage-type process.

The Cosmic Medium is therefore not a passive background. It participates in the formation and evolution of physical structures throughout the Observable World.

## 1.5. Emergent Gravity, Space, and Time

**Space** serves as a reservoir for the Cosmic Medium. It is a finite, boundless three-dimensional Hypersphere forming the surface of the four-dimensional Nucleus.

Within WUC, particles in the four-dimensional Nucleus possess four spatial coordinates and four spatial momentum components. When these particles enter the three-dimensional Hypersphere World, their fourth spatial coordinate is no longer directly accessible to three-dimensional observers. Its evolution is represented in the World by **Time**, while the fourth spatial momentum component is represented by **Energy**.

Thus, in WUC, **Time is our three-dimensional description of the evolution of the fourth spatial position, expressed through the fundamental expansion speed (c).**

The four-dimensional Nucleus expands along the fourth spatial dimension at speed (c), which subsequently serves as the electrodynamic and gravitodynamic constant in the World. Its radius is related to Absolute Cosmological Time ($\tau$) by

$$R=c\tau$$

Consequently, Time is not introduced as an independent fourth coordinate of spacetime. Instead, it represents the evolution of the fourth spatial coordinate associated with the expansion of the Nucleus.

This interpretation establishes a conceptual correspondence between the fourth spatial coordinate and Time, and between the fourth spatial momentum component and Energy:

$$Fourth\ spatial\ coordinate\ \rightarrow\ Time$$

$$Fourth\ spatial\ momentum\ component\ \rightarrow Energy$$

**Gravitation** is a manifestation of the Cosmic Medium. Within WUC, the gravitational parameter (G) is associated with the energy density of the Medium and evolves with cosmological time.

WUC therefore proposes that **Space, Time, and Gravitation are emergent physical phenomena whose properties are inseparable from the expanding four-dimensional Nucleus and the Cosmic Medium.**

# 2. Observable World

## 2.1. Physical Structure of the Observable World

Within World–Universe Cosmology (WUC), the World is a finite, boundless three-dimensional Hypersphere forming the surface of an expanding four-dimensional Nucleus. The Nucleus expands along the fourth spatial dimension at speed (c).

The Observable World, also called the Hubble Bubble, is the region of the Hypersphere accessible to astronomical observations. It is part of the World rather than a separate physical structure.

The essential distinction is that the World is a physical three-dimensional Hypersphere, whereas the Observable World is an observationally accessible region of that Hypersphere.

Its characteristic radius is

$$R=c\tau$$

The Hypersphere geometry describes expansion without a preferred center on its three-dimensional surface.

The evolving dimensionless World Parameter

$$Q=R/a$$

determines the characteristic scales and physical properties of the World in WUC.

## 2.2. Energy Density of the Observable World

WUC introduces the fundamental Surface Tension ($\sigma_0$) of Cosmic Bubbles as a primary physical parameter:

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

Here, h denotes Planck's constant.

The total energy of the Hubble Bubble is expressed in WUC as

$$E_{OW}=4\pi R^2\sigma_0$$

Its average energy density follows as

$$\rho_{OW}=\frac{3\sigma_0}{R}=\frac{3\sigma_0}{a}\times Q^{-1}$$

The World Parameter can also be written as

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

where

$$t_0=a/c$$

The resulting energy density varies inversely with the characteristic radius of the Observable World.

Continuous creation of UCM within the expanding Nucleus provides the WUC mechanism for the evolving material content of the World.

World-Universe Cosmology also introduces the Angular Momentum flux density ($J_h$), which characterizes the transfer of Angular Momentum from the four-dimensional Nucleus into the three-dimensional World.

$$J_h=\frac{h}{a^2t_0}$$

The total Angular Momentum flux across the Hubble Bubble surface is

$$I_h=4\pi R^2J_h$$

The resulting flux depends on the Hubble Bubble surface area and the proposed Angular Momentum flux density.

WUC postulates the relationship

$$\sigma_0=J_h$$

Surface Tension characterizes the energy of a Cosmic Bubble boundary; Angular Momentum flux density characterizes the transfer of collective Angular Momentum from the four-dimensional Nucleus into the three-dimensional World.

Their proposed equality is a fundamental WUC postulate, whose physical implications require quantitative testing.

The fundamental rest-energy scale and Planck's constant are expressed as

$$E_0=\sigma_0a^2 \qquad h=\sigma_0a^2t_0$$

These relations connect the proposed global energy and Angular Momentum descriptions of the World.

## 2.3. Critical Energy Density and Gravitational Parameter

A central WUC assumption is that the average energy density of the Observable World ( $\rho_{OW}$), equals the critical energy density ( $\rho_{cr}$).

To derive the latter, consider a sphere of radius ( $R_M$) enclosing an amount of matter characterized by ($M$). Its enclosed mass is the critical mass density multiplied by the sphere's volume. At critical density, the recession speed $H\times R_M$ (where $H=c/R$ is the Hubble parameter and $R$ is the radius of the Observable World) is set equal to the escape speed $v_{esc}$:

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

Solving this condition for the critical energy density ( $\rho_{cr}$) gives:

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

Using the critical-density expression, WUC obtains

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

Here $\mu_g = \frac{4\pi G}{c^2}$ denotes the gravitomagnetic parameter, while $\rho_{CM} = \frac{2}{3}\rho_{cr}$ denotes the Cosmic Medium energy density, taken in WUC to be two-thirds of the critical energy density. Because $H \propto R^{-1}$, the WUC scaling relations imply $G \propto R^{-1}$.

In this framework, the cosmological parameters ($G$) and ($H$) are linked through the homogeneous and isotropic Cosmic Medium energy density ($\rho_{CM}$).

WUC further identifies the critical energy density ($\rho_{cr}$) with the average energy density of the Observable World ($\rho_{OW}$):

$$\rho_{cr} = \frac{3c^4}{8\pi GR^2} = \rho_{OW} = \frac{3hc}{a^3R} = \frac{3\sigma_0}{a} \times Q^{-1}$$

Equating these energy-density expressions yields the WUC relation for the gravitational parameter:

$$G = \frac{a^2c^4}{8\pi hc} \times Q^{-1} = \frac{c^4}{8\pi\sigma_0 a} \times Q^{-1}.$$

## 2.4. Geometric Possibility of Parallel Hubble Bubbles

In WUC, the World is a **Hubble Bubble** with the radius $R$, the volume $V_W = 4/3\,\pi R^3$, and the energy density of a spherical surface $\sigma_0$ [1]. The World is a part of the 3D Finite Boundless Hypersphere of 4D Nucleus of the World, which is expanding in Its fourth spatial dimension. As a result, the Hypersphere with the 3-dimensional surface volume of $V_H = 2\pi^2R^3$ is evenly stretched. The ratio of $V_H$ to $V_W$ is:

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

The geometric ratio permits a hypothetical partition into four Hubble-Bubble-sized regions. This is a geometric possibility within WUC, not an observation of four independent Worlds; the present paper examines the Observable World.

According to Wikipedia [2], the Cosmic Microwave Background Radiation (CMBR) Cold Spot is a region of the sky seen in microwaves that has been found to be unusually large and cold relative to the expected properties of CMBR. The "Cold Spot" is ≅ 70 $\mu K$ colder than the average CMBR temperature (approximately 2.725 K), whereas the root mean square of typical temperature variations is only 18 μK.

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

The CMB Cold Spot may serve as an observational target for future quantitative WUC investigations. Its existence alone does not demonstrate the presence of another Hubble Bubble.

# 3. Universe-Created Matter

## 3.1. Universe-Created Particles

WUC proposes that the World contains Ordinary Matter and Universe-Created Matter (UCM), whose

fundamental constituents are Universe-Created Particles (UCPs). The seven proposed UCP species have definite rest energies (**Table 1**), participate in the WUC Weak Interaction, and undergo annihilation processes. WUC associates these processes with the generation of Ordinary Particles and radiation. Their properties and consequences are model predictions requiring quantitative tests.

**Table 1.** Seven proposed Universe-Created Particles and their rest energies.

| Particle | Rest Energy | Value (eV) | Value (kg) |
|---|---|---|---|
| UCF1 | $K_U^{-2}E_0$ | 1.3149948 $TeV$ | $2.3441912 \times 10^{-24}$ |
| UCF2 | $K_U^{-1}E_0$ | 9.5959804 $GeV$ | $1.710638886 \times 10^{-26}$ |
| DIRAC | $K_U^0E_0$ | 70.025252 $MeV$ | $1.2483135 \times 10^{-28}$ |
| ELOP | $2/3K_U^1E_0$ | 340.66596 $keV$ | $6.07292 \times 10^{-31}$ |
| UCF3 | $K_U^2E_0$ | 3.7289394 $keV$ | $6.6474383 \times 10^{-33}$ |
| UCF4 | $K_U^4E_0$ | 0.19857107 $eV$ | $3.53985085 \times 10^{-37}$ |
| XION | $1/2K_U^6\,E_0$ | 5.2870895 $\mu eV$ | $9.4250931 \times 10^{-42}$ |

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

$$E_0 = hc/a = 70.025252\ MeV$$

Where $h$ is the Planck constant and $c$ is the Gravitodynamic constant. Values of UCPs in (kg) presented for theoretical calculations in Section 3.4. These particles are "dark" , **optically invisible**, when astronomers observe the World with telescopes only.

WUC introduces a fundamental dimensionless **Universe Constant $K_U$,** that characterizes the underlying physical structure of the Model and enters the relationships among fundamental quantities and the predicted rest energies of Universe-Created Particles [3]:

$$K_U^{-1} = 4\pi^3 + \pi^2 + \pi = 137.036303776$$

The notation $K_U$ emphasizes its role as a constant associated with the Eternal Universe and distinguishes it from the evolving World Parameter $Q$.

Astronomical observations across the electromagnetic spectrum provide opportunities to test the predicted UCP signatures. A correspondence between an observed spectral feature and a predicted energy is a testable connection, not by itself identification of a UCP.

WUC distinguishes two proposed contributions to the radiation of Macroobjects (MOs):

- Ordinary Matter emits electromagnetic radiation through processes involving charged particles and atoms.
- UCP annihilation is proposed to contribute radiation whose energy distribution depends on the rest energies and interactions of the UCP components (**Table 1**).

WUC proposes multicomponent UCM system consisting of two couples of co-annihilating UCPs: a heavy fermion UCF1 (1.3 TeV) and a light fermion – DIRAC (70 MeV) that is a dipole of Dirac's monopoles with

charge $\mu=\frac{e}{2}K_U^{-1}$ ($e$ is an elementary charge and $K_U$ is the Universe constant); a heavy fermion UCF2 (9.6 GeV) and a light fermion– ELOP (340 keV) that is a dipole of preons with electrical charge e/3; fermions UCF3 (3.7 keV) and UCF4 (0.2 eV), and boson XION (5.3 $\mu eV$).

The proposed multicomponent UCM system provides a common physical basis for two applications:

- The spectral characteristics and spatial distributions of high-energy emission from Macroobjects.
- The composition and characteristic scales of UCM Cores and shells in Superclusters, Galaxies, Globular Clusters, and Extrasolar Systems.

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 $\mu eV$ are found in spectra of diffuse gamma-ray background and the emissions of various MOs in the World [4]. 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.

## 3.2. Fermionic Nature of Universe-Created Particles

Within WUC, UCPs are continuously generated by the Eternal Universe in the expanding four-dimensional Nucleus. The model provisionally classifies UCF1–UCF4, DIRAC, and ELOP as fermionic constituents of UCM. This classification is a model assumption to be tested through its physical consequences.

XION is proposed as the bosonic UCP responsible for the Le Sage-type mechanism of gravitation in WUC. Its physical role is specified within the model and requires independent observational tests.

The fermionic UCP hypothesis provides the basis for calculating the characteristic scales of compact UCM Cores. Different predicted rest energies lead to different Core and shell dimensions.

## 3.3. Weak Interaction

WUC expresses the evolution of the gravitational parameter through the scaling relation [4]:

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

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

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

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

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

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

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

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

$$n_W^{cr}=5.28424\times10^{10}\ m^{-3}$$

WUC proposes a Weak Interaction among UCPs that contributes to the integrity of UCM Cores and Cosmic Bubbles. Its characteristic strength, range, interaction volume, and critical particle concentration are defined by the preceding equations. These quantities can be used to calculate structural conditions for individual Macroobjects.

## 3.4. Macroobject Cores Built Up From Fermionic Universe-Created Matter

Narain, *et al.* [5] investigated compact fermionic dark-matter stars numerically without specifying the particular dark-matter particle spectrum proposed in WUC. In World–Universe Cosmology, we develop analytical relationships for Macroobject Cores based on the predicted rest energies of Universe-Created Particles and the fundamental parameters of the Model. The resulting equations determine the characteristic Core parameters and establish their dependence on the evolving World Parameter (Q).

WUC models Macroobject Cores as fermionic UCM structures. Their characteristic dimensions and limiting properties are calculated from the predicted UCP rest energies and the compact-fermion scaling relations.

The proposed hierarchy of Superclusters, Galaxies, Globular Clusters, and Extrasolar Systems has two common structural features:

- A central Core containing Universe-Created Particles.
- Surrounding shells containing UCPs and Ordinary Particles.

Considering the main principle of WUC (all physical parameters can be expressed in terms of $K_U$, $Q$, small integer numbers, and $\pi$), we modify the published theory of Fermionic Compact Stars (FCS) developed by G. Narain, *et al.* [5] provide the compact-fermion scaling framework used here. WUC applies it to the proposed UCP constituents $m_f$ in accordance with following equations:

- Maximum mass: $M_{max}=A_1M_F$
- Minimum radius: $R_{min}=A_2R_F$
- Maximum density: $\rho_{max}=A_3\rho_0$

The characteristic compact-fermion scales are

$$M_F=\frac{M_P^3}{m_f^2}$$

$$R_F=\frac{M_P}{m_f}\frac{L_{Cf}}{2\pi}$$

$$\rho_0=\frac{hc}{a^4}$$

and $M_P$ is Planck mass, $L_{Cf}$ is a Compton length of the fermion. $A_1$, $A_2$, and $A_3$ are parameters.

For the WUC estimates, the following numerical coefficients are adopted:

- $A_1=\pi/6$ (instead of $A_1=0.384$ taken by G. Narain, *et al.* [5]).
- $A_2=\pi$ (instead of $A_2=3.367$ taken by G. Narain, *et al.* [5]).
- Then $A_3$ will equal to $A_3=(\frac{m_f}{m_0})^4$

So, the radius of FCS is proportional to the fermion Compton length $L_{Cf}$.

Within WUC, the Planck-scale quantity is written as:

$$M_P = 2m_0 Q^{1/2}$$

where a Basic Mass unit is: $m_0 = h/ac$. In case of UCP DIRAC, we have the maximum mass equals to:

$$M_{DIRAC} = \frac{\pi}{6}\frac{8m_0^3}{m_0^2} Q^{3/2} = \frac{4\pi}{3} m_0 Q^{3/2}$$

The corresponding proposed maximum value for an Extrasolar System is:

$$M_{ESS} = 3M_{DIRAC} = 4\pi m_0 Q^{3/2} = 4\pi\sigma_0 R_{ESS}^2$$

The associated surface-density parameter is defined as:

$$\sigma_0 = \frac{m_0}{a^2}$$

The proposed maximum radius of an Extrasolar System is:

$$R_{ESS} = aQ^{3/4}$$

The proposed minimum radius of a DIRAC Core is:

$$R_{DIRAC} = \pi\frac{M_P}{m_0}\frac{a}{2\pi} = \pi\frac{2m_0}{m_0}\frac{a}{2\pi} Q^{1/2} = aQ^{1/2}$$

The ratio of these characteristic radii is:

$$R_{ESS}/R_{DIRAC} = Q^{1/4}$$

These characteristic radii differ by approximately ten orders of magnitude in the proposed WUC scaling.

The corresponding proposed maximum density of the DIRAC Core is:

$$\rho_{DIRAC} = \frac{4\pi/3 m_0 Q^{3/2}}{4\pi/3 a^3 Q^{3/2}} = \frac{m_0}{a^3} = \rho_0$$

The proposed maximum number concentration of DIRAC particles is:

$$n_{DIRAC} = \rho_0/m_0 = a^{-3}$$

For another UCP species, the characteristic particle scale is written as:

$$m_{UCP} = K_U^n m_0$$

where n ∈ (-2 → 6), we should replace in the obtained equations

$$m_o \to m_{UCP} \quad \text{and} \quad a \to L_{UCP}$$

where $L_{UCP}$ is a Compton Length of a proper UCP.

## 3.5. Macroobject Shell Model [6]

The WUC Shell Model associates the hierarchy of Macroobjects with nested UCM-rich Cores and shells. Their characteristic dimensions depend on the proposed UCP rest energies and interactions. **Table 2** summarizes the calculated present-epoch Core parameters.

The resulting assignments of UCP components to different structural scales are:

- Cores containing UCF1 and/or UCF2 are proposed to occur in Macroobjects across the hierarchy.
- A DIRAC-rich outer shell is associated with Extrasolar Systems.

- Shells containing electron–positron plasma and ELOPs are associated with Globular Clusters.
- A UCF3-rich outer shell is associated with Galactic Cores.
- A UCF4-rich outer shell is associated with Supercluster Cores.

**Table 2.** WUC estimates of Macroobject Core parameters for different fermionic constituents in the present epoch.

| Fermion | Rest Energy $E_f, MeV$ | Core Mass $M_{max}, kg$ | Core Radius $R_{min}, m$ | Core Density $\rho_{max}, kgm^{-3}$ | Macroobject |
|---|---|---|---|---|---|
| UCF1 | $1.3 \times 10^{6}$ | $1.93 \times 10^{30}$ | $8.6 \times 10^{3}$ | $7.2 \times 10^{17}$ | All |
| UCF2 | $9.6 \times 10^{3}$ | $1.93 \times 10^{30}$ | $8.6 \times 10^{3}$ | $7.2 \times 10^{17}$ | All |
| DIRAC | 70 | $3.46 \times 10^{32}$ | $1.54 \times 10^{6}$ | $2.3 \times 10^{13}$ | Extrasolar System |
| Electron-Positron | 0.51 | $6.50 \times 10^{36}$ | $2.89 \times 10^{10}$ | $6.5 \times 10^{4}$ | Globular Cluster |
| ELOP | 0.34 | $1.46 \times 10^{37}$ | $6.51 \times 10^{10}$ | $1.3 \times 10^{4}$ | Globular Cluster |
| UCF3 | $3.7 \times 10^{-3}$ | $1.22 \times 10^{41}$ | $5.43 \times 10^{14}$ | $1.8 \times 10^{-4}$ | Galaxy |
| UCF4 | $2 \times 10^{-7}$ | $4.30 \times 10^{49}$ | $1.92 \times 10^{23}$ | $1.5 \times 10^{-21}$ | Supercluster |

# 4. Super-Structures

## 4.1 Chicken-Egg Structure

Within WUC, Galaxies arise through an Explosive Volcanic Rotational Fission of overspinning Supercluster Cores containing UCF1–UCF4. The resulting Galaxy Bubble is described by a three-part "chicken-egg" structure:

- "Yolk": a rotating, high-viscosity UCP Core containing UCF1–UCF3 and one-third of the proposed total galactic Matter.
- "Albumen": the lower-viscosity Interstellar Medium (ISM), dominated by UCF3 and containing the remaining two-thirds.
- "Membrane" – boundary between ISM and Intergalactic Medium with surface energy density $\sigma_0$ . ESS emerge due to the Explosive Volcanic Rotational Fission of Overspinning UCM galaxy Core and entering ISM. As a result, galaxy Bubble expands in the plane of the spinning galaxy's UCM Core and becomes a Disk Bubble.

## 4.2. Super-Objects

The WUC hierarchy links Superclusters, Galaxies, and Extrasolar Systems through common physical mechanisms [6].

We examine their characteristic scales using UCP Compton lengths, Cosmic Bubble boundaries, and the proposed Weak Interaction.

### 4.2.1. Laniakea Supercluster

The Laniakea Supercluster (LSC) contains the Milky Way (MW) and approximately 100,000 large galaxies (**Figure 1**). Tully, *et al.* (2014) delineated it as a basin of attraction using reconstructed peculiar-velocity flows. Its inferred total mass is $\sim 10^{17} M_{\odot}$, and its characteristic extent is about 160 Mpc (520 Mly) [7].

Neighboring large structures include the Shapley, Hercules, Coma, and Perseus–Pisces Superclusters. The estimated distance from Earth to the center of the Laniakea Supercluster (LSC) is $\sim 250\ Mly$ .

The reconstructed peculiar-velocity flows delineate neighboring basins of attraction. WUC uses this observed large-scale organization as a basis for its "Patchwork Quilt" description of the Visible World. The boundaries are inferred from galaxy distances and velocity reconstructions.

The Great Attractor is an extended concentration of matter in the Hydra–Centaurus region toward which reconstructed flows within Laniakea converge. Parts of this region are obscured optically by the Milky Way's Zone of Avoidance. Earlier flow models assigned it a mass of order $10^{16} M_{\odot}$; such estimates depend on the adopted spatial extent and dynamical model. Within WUC, UCM is proposed to contribute to this concentration.

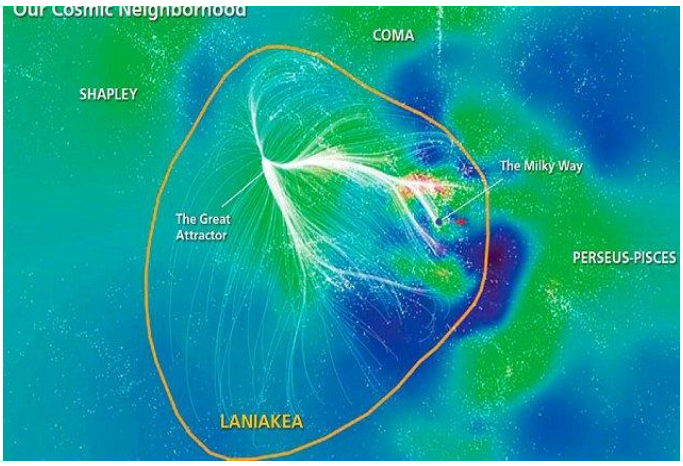



**Figure 1**. Laniakea Supercluster. Adapted from [7]

Within WUC, the mapped flow basin is investigated as a possible Supercluster with a UCM-rich Core. The physical binding and internal structure of this proposed Core require quantitative tests.

WUC relates the global Hubble parameter to the homogeneous Cosmic Medium. Its 2013 calculation [8] gives:

$$H_0 = 68.73 kms^{-1} Mpc^{-1},$$

For comparison with observations, a 2021 CMB-based analysis reported (Addison, 2021) [9]:

$$H_0 = 68.7 \pm 1.3 kms^{-1} Mpc^{-1}.$$

The WUC calculation agrees numerically with the quoted CMB-based value within its reported uncertainty. This comparison tests the numerical prediction without establishing the model's proposed physical mechanism.

Large dynamical mass-to-light ratios inferred for galaxy clusters, including Coma, indicate substantial nonluminous gravitational components. WUC attributes these components to UCM and proposes tests of their spatial distribution and radiation signatures.

Laniakea and its neighboring flow basins illustrate the large-scale organization underlying the WUC Patchwork Quilt. The proposed population of more than $10^3$ Luminous Superclusters and their UCM-rich Cores remain subjects for quantitative investigation.

### 4.2.2. Boötes Void

WUC interprets the Boötes Void in terms of UCM Bubbles associated with Superclusters. The Bubble dimensions are derived from the proposed UCP components and their characteristic scales.

The main difference between Galaxies and Superclusters is in their outer shells, which composed of particles UCF3 for Galaxies and of UCF4 for Superclusters. Considering that a Compton length of particles UCF4, $L_{UCF4}$, is considerably larger than the Compton length of particles UCF3, $L_{UCF3}$ :

$$L_{UCF4}=K_U^{-2}L_{UCF3}$$

we can calculate a diameter of Boötes Bubble (BB) $D_{BB}$ , mass $M_{BB}$ , average density $\rho_{BB}$ , and concentration of UCF4 $n_{UCF4}^{BB}$ :

$$D_{BB}=L_{UCF4}\times Q^{3/4}=\frac{a}{K_U^4}\times Q^{3/4}=0.537\ Bly$$

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

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

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

In WUC, the proposed UCF4 Weak Interaction contributes to the integrity of these Bubbles.

It is worth noting that the energy density of the Cosmic Medium $\rho_M=2/3\,\rho_{cr}$ . Hence, the energy density of Superclusters' Bubbles $\rho_{SB}$ is 79.5 times larger than an energy density of Supervoids $\rho_{SV}$ , which have a concentration of particles UCF4 $n_{DMF4}^{SV}$ smaller than $n_W^{cr}$ :

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

WUC proposes two Boötes Bubbles extending on opposite sides of a Supercluster, with a combined characteristic scale of approximately one billion light-years. Their geometry is a prediction to be examined observationally.

The proposed Bubbles contain UCM clumps capable of producing high-energy radiation through UCP annihilation. Their predicted spatial structure and emission provide observational tests.

To confirm the existence of BBs we should make measurements of high-energy X-rays and gamma rays from the Boötes. Considering the high concentration of particles UCF4 in BBs (that is higher than $n_W^{cr}$ ), it is possible to observe "Unidentified Infrared Emission Bands" (UIB), which occur around peaks at 3.3, 6.2, 7.7, 8.6, 11.2, and 12.7 μm [10].

In WUC, the observed Unidentified Infrared Emission Bands are interpreted as possible signatures of the self-annihilation of UCF4 particles and bi-UCF4 pairs. This proposed mechanism provides a specific physical hypothesis that can be tested through quantitative comparisons with the observed infrared spectra.

## 4.3. Galaxies

### 4.3.1. Milky Way and Andromeda Galaxy

The Milky Way is a spiral galaxy in the Local Group with its estimated visible stellar disk diameter $D_{MW}=185\pm 15\ kly$ , thickness of thin stellar disk about $2\ kly$ and mass $M_{MW}=(1.6\text{-}3.2)\times 10^{42}kg$ [11].In WUC, the Milky Way is modeled as a Disk Bubble bounded by the Intergalactic Medium whose boundary with the Intergalactic Medium has a surface energy density $\sigma_0$ . The Disk Bubble contains Interstellar Medium (ISM) and (100 – 400) billion ESS. According to WUC, mass of MW equals to:

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

We calculate $D_{MW}$ by the following equation:

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

The calculated range of the Milky Way Disk Bubble diameter is consistent with the astronomical estimate of the visible stellar disk diameter. This agreement supports the internal consistency of the WUC scaling relationship and motivates further quantitative observational tests.

- Mass of MW : $M_{MW}=1.92\times10^{42}\ kg$
- Average density : $\rho_{MW}=4.20\times10^{-20}\ kg\ m^{-3}$
- Average concentration of UC particles UCF3 in ISM : $n_{DMF3}^{ISM}=3.04\times10^{11}\ m^{-3}$

that is significantly larger than the critical concentration $n_W^{cr}$ (see Section 3.5). It means that weak interaction between UCM particles UCF3 provides integrity of MW's disk bubble.

**Andromeda Galaxy** (AG) is a barred spiral galaxy approximately 2.5 Mly from Earth and the nearest large galaxy to MW with about $10^{12}$ stars. It has an estimated visible stellar disk diameter ~220 kly and mass $(3\pm1)\times10^{42}\ kg$ [12].

The observed parameters of the Andromeda Galaxy are comparable to those of the Milky Way. Within WUC, the same scaling relationships may therefore be applied to Andromeda, provided that the assumed surface energy density and boundary conditions are appropriate. Independent observational comparisons are required to test this application.

## 4.3.2. Fermi Bubbles

The Fermi Bubbles are extended gamma-ray structures above and below the Milky Way's plane [13]. Their measured angular extent, spatial boundaries, and radiation spectra provide tests of the WUC Bubble model. WUC investigates these structures as UCM-rich Bubbles connected with the Galactic Core.

Gamma-ray observations reveal spatially extended emission and substructures that constrain the proposed distribution of UCP components.

Observed X-ray structures near the Galactic Centre provide additional spatial constraints on the proposed transport of UCM.

WUC associates the radiation of these Bubbles with the annihilation and redistribution of UCPs.

The gamma-ray emission observed toward M31 provides another possible quantitative test of the proposed UCF2 energy scale near 9.6 GeV; spectral features do not alone identify a UCP.

**The WUC interpretation [4] is:**

- The Galactic Core contains UCF1, UCF2, and UCF3. The model associates UCF2 annihilation with part of the GeV emission and proposes that Core activity supplies energetic UCP components.
- Bipolar transport from the Galactic Core distributes UCP components into the surrounding halo.
- UCF1 and UCF2 processes are proposed to contribute gamma-ray emission, while UCF3-related processes are associated with the extended X-ray structures.
- FBs are bubbles whose boundary with the Intergalactic Medium has a surface energy density $\sigma_0$. These bubbles are filled with UC particles: UCF1, UCF2, and UCF3. In our Model, FBs are MOs with mass $M_{FB}$ and diameter $D_{FB}$, which are proportional to: $M_{FB}\propto Q^{3/2}$ and $D_{FB}\propto Q^{3/4}$ respectively.

According to WUC, diameter of FBs equals to:

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

where $L_{DMF3}$ is Compton length of particles UCF3. Mass and average density $\rho_{FB}$ are:

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

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

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

The calculated characteristic diameter of the Fermi Bubbles is 28.6 kly, comparable to reported observational scales of 25–32.6 kly. A more precise quantitative comparison requires consistent definitions of the observed and calculated Bubble dimensions.

# 4.4. Globular Clusters

Globular Clusters are compact stellar systems, providing a distinct scale in the proposed WUC hierarchy of Macroobjects.

The Milky Way contains more than 150 known Globular Clusters, whose sizes, stellar populations, and dynamics provide observational constraints.

Within WUC, Globular Clusters are proposed to contain electron–positron and ELOP-rich components organized into a Core–shell structure. This hypothesis can be investigated through quantitative comparisons with observed cluster dimensions, stellar dynamics, and radiation spectra. In particular, identifying observational signatures associated with the predicted ELOP rest energy would provide an important test of the proposed physical composition.

# 4.5. Extrasolar Systems

## 4.5.1. Solar System

Extrasolar Systems (ESS) are Bubbles with a boundary between ESS and Interstellar Medium that has a surface energy density $\sigma_0$ . In WUC, the Solar Bubble is a proposed structure surrounding the Sun, with its boundary characterized by the fundamental Surface Tension. Its calculated radius represents a theoretical prediction that requires independent observational verification.

$$R_{SB}=\left(\frac{3M_\odot c^2}{2\pi\sigma_0}\right)^{1/2}\cong 1.6\times 10^{15}m\cong 0.17\ ly$$

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

## 4.5.2. Dark (Invisible) Stars

Within WUC, Dark (Invisible) Stars are proposed Macroobjects containing UCM-rich Cores that contribute to their gravitational effects while producing little observable electromagnetic radiation. Their possible existence can be investigated through gravitational interactions with neighboring objects, orbital dynamics, and searches for radiation associated with UCP annihilation.

### 4.5.3. Binary Stars

Cygnus X-1 is a well-observed compact-object binary system whose orbital dynamics and X-ray emission provide quantitative constraints on its physical structure. Within WUC, such systems may contain UCM-rich Cores. The proposed interpretation can be tested through comparisons with measured orbital parameters, radiation spectra, and their temporal variability.

# Conclusion

World–Universe Cosmology (WUC) proposes that Great Structures—from Superclusters and Galaxies to Globular Clusters and Extrasolar Systems—belong to a connected physical hierarchy. The Eternal Universe continuously generates Universe-Created Matter (UCM) within the expanding four-dimensional Nucleus. In the three-dimensional World, Universe-Created Particles (UCPs), the Cosmic Medium, and the evolution of Angular Momentum are proposed to govern the formation and development of Macroobjects. The finite, boundless World is described as a three-dimensional Hypersphere expanding along the fourth spatial dimension.

The fixed Universe Constant ($K_U$), the evolving World Parameter (Q), and the characteristic Compton lengths of Universe-Created Particles provide the basis for the proposed structural scaling relations. The Macroobject Shell Model associates different levels of the hierarchy with different UCP components. Rotational Fission provides a proposed mechanism for transferring Matter and Angular Momentum from parent Cores to newly formed systems, while UCP annihilation supplies internal energy and generates Ordinary Matter.

The structural relations developed in this paper connect the proposed microscopic UCP scales with astronomical dimensions. Applications include the Milky Way Disk Bubble, Fermi Bubbles, Boötes Bubbles, and the Solar Bubble. The calculations provide characteristic sizes and internal configurations within WUC; comparisons with observed dimensions are tests of these relations, not direct detections of UCPs. The Laniakea flow basin provides an observational example of the large-scale organization that WUC describes as a Patchwork Quilt, while the proposed physical nature of its Core remains to be established.

The most important task is to subject these proposals to independent quantitative tests. Relevant observations include reconstructed large-scale velocity fields, the dimensions and density profiles of Cosmic Bubbles, the dynamics of Galaxies and stellar systems, and spatially resolved gamma-ray, X-ray, infrared, and radio spectra. In particular, the proposed Boötes Bubbles require searches for their predicted geometry and radiation signatures; the proposed UCP contributions to Fermi Bubble emission require spectral and spatial tests. An observed energy feature or agreement in size alone cannot establish a new particle: correlated signatures, measurement uncertainties, and alternative physical sources must be assessed.

The central conclusion of this work is that Great Structures, extending from Superclusters and Galaxies to Globular Clusters and Extrasolar Systems, can be described within WUC as different-scale manifestations of common physical constituents and mechanisms. The proposed relationships connect the fundamental properties of Universe-Created Particles with the dimensions, internal structures, and evolution of astronomical Macroobjects. WUC provides quantitative predictions that can be compared with independent astronomical observations. The ultimate validation of these relationships requires reproducible measurements and unambiguous identification of the proposed physical mechanisms and UCP components.

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