

Universe-Created Particles

From Fundamental Principles to Observational Evidence

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Abstract

The World–Universe Model (WUM) proposes that the physical World is a finite, boundless three-dimensional Hypersphere forming the surface of an expanding four-dimensional Nucleus embedded in the Eternal Universe. The Nucleus expands along the fourth spatial dimension with speed c . Within this framework, Matter is not treated as a primordial substance introduced solely through initial conditions. **Universe-Created Matter (UCM)** is continuously generated by the Eternal Universe within the expanding 4D Nucleus through the formation of **Universe-Created Particles (UCPs)**.

UCPs constitute a fundamental physical component of WUM. They possess definite rest energies and form a discrete multicomponent system. They participate in the formation and evolution of Macroobjects and, through specific interactions and pair-annihilation processes, in the generation of Ordinary Matter. **Ensembles of UCPs carry intrinsic angular momentum, physically resembling microscopic “air vortices.”** WUM therefore relates the origin of Matter to the origin of angular momentum in physical systems.

The purpose of the present work is to develop the UCP concept from the fundamental principles of WUM and to compare the predicted particle spectrum with independent astronomical and experimental observations. Particular attention is given to particle-specific quantitative signatures and to theoretically related UCP couples, for which correlated observational evidence can provide a substantially stronger test than isolated spectral correspondences. The broader physical roles of UCM—including the formation of the Cosmic Medium, the operation of UCP Annihilation Reactors, the generation of Ordinary Matter, and the proposed microscopic mechanism of Gravitation—are also considered.

The central question addressed in this paper is: Do independently observed phenomena provide quantitative evidence for the system of Universe-Created Particles predicted by WUM? The objective is not merely to identify qualitative similarities, but to determine whether the predicted rest energies, physical products, astrophysical manifestations, and interconnected physical roles of the complete UCP–UCM system have quantitative counterparts in Nature.

1. Introduction — The Chicken-and-Egg Problem in Cosmology

One of the most fundamental questions in physics is also one of the simplest to formulate:

Where did Matter come from?

Any cosmological theory that attempts to describe the physical World must ultimately confront this question. Matter forms particles, atoms, stars, planets, galaxies, clusters, and the observable large-scale structure of the Cosmos. Explaining the evolution of these systems, however, does not by itself explain the origin of the **Matter** from which they are constructed.

This creates a cosmological version of the familiar **chicken-and-egg problem**. The evolution of the World requires **Matter**, while the origin of **Matter** requires a physical process capable of producing it. If **Matter** is simply specified as part of an initial state, its physical origin remains unexplained.

The World–Universe Model approaches this problem differently.

WUM distinguishes between the **Eternal Universe** and the **World**. The Universe exists eternally. The World has a finite cosmological age and is a finite, boundless three-dimensional Hypersphere forming the surface of an expanding four-dimensional Nucleus. The Nucleus expands along the fourth spatial dimension with speed c .

Within this framework, the Matter present in the World need not have been supplied entirely at its Beginning. WUM proposes that **Universe-Created Matter is continuously generated by the Eternal Universe within the expanding 4D Nucleus through the formation of Universe-Created Particles [1]**.

UCPs are therefore not an auxiliary addition to the Model. They are a fundamental part of its physical description of the World.

This changes the cosmological question. Instead of asking only how an initially prescribed inventory of Matter evolved into the structures observed today, WUM asks what particles are continuously created by the Eternal Universe, what their physical properties are, and whether their existence can be tested observationally.

This question becomes scientifically meaningful only if the proposed particles possess definite and testable properties. WUM assigns specific rest energies to its UCPs and organizes them into a discrete multicomponent system [1-5]. Consequently, the theory can be confronted quantitatively with astronomical and experimental observations.

The theoretical construction begins with the fundamental quantities of WUM that **provide the basis for the rest-energy spectrum** of Universe-Created Particles. The complete UCP system spans more than seventeen orders of magnitude in rest energy. Some UCPs form theoretically related couples, while others occupy distinct positions in the particle spectrum. Their proposed roles extend from microscopic particle processes to the structure and evolution of astronomical Macroobjects.

Universe-Created Particles also connect two fundamental problems that are commonly considered separately: the **origin of Matter** and the **origin of angular momentum**. **Ensembles of UCPs carry intrinsic angular momentum, physically resembling microscopic “air vortices.”**

Macroobjects containing UCP components therefore inherit angular momentum as a natural property of their formation and evolution.

The scientific value of this framework depends ultimately on observation. The purpose of the present paper is therefore to place the UCP hypothesis on quantitative observational and experimental trial.

The purpose of the present paper is therefore to place the UCP hypothesis on quantitative observational and experimental trial. We first develop the concept of Universe-Created Particles from the fundamental principles of WUM, including the four-spatial-dimensional description of momentum and rest energy. We then introduce the fundamental quantities that determine the UCP rest-energy scales, examine **DIRAC as the UCP associated with the fundamental rest-energy scale**, and present the complete UCP system.

The physical roles of Universe-Created Matter are subsequently considered, including the formation of the **Cosmic Medium**, the formation and evolution of UCM Cores, angular momentum and Rotational Fission, UCP Annihilation Reactors (UARs), the generation of Ordinary Matter, and the proposed role of **XIONs in Gravitation**.

The theoretical predictions are then compared with independent astronomical and experimental observations. Particular attention is given to quantitative correspondence between predicted UCP rest energies and observed characteristic phenomena. Individual UCPs are examined together with the more restrictive tests provided by theoretically related UCP couples.

The analysis is guided throughout by one central question:

Do independently observed phenomena provide quantitative evidence for the system of Universe-Created Particles predicted by WUM?

A convincing answer requires more than qualitative agreement. It requires particle-specific quantitative evidence, consistency among independent observations, and predictions sufficiently definite that future measurements can confirm, constrain, or falsify them.

The following sections develop this test from the fundamental principles of WUM.

2. Eternal Universe and the Expanding 4D Nucleus

The concept of Universe-Created Particles cannot be separated from the geometrical and physical structure of WUM. Their origin follows from the distinction between the **Eternal Universe** and the **World** and from the four-spatial-dimensional geometry of the Model.

2.1. Eternal Universe and the World

WUM distinguishes fundamentally between two concepts that are often treated as synonymous: the **Universe** and the **World**.

The **Universe is eternal**. It has no Beginning and no End and constitutes the eternal physical reality within which the World exists and evolves.

The **World**, by contrast, has a finite cosmological age. It began as a fluctuation in the Eternal Universe and has evolved continuously since its Beginning. The World is therefore not identified with the entire Universe; it is a physical system embedded in the Eternal Universe.

This distinction eliminates the requirement that the Universe itself must originate at a finite moment. The Beginning refers to the World, not to the Eternal Universe.

The World is described geometrically as a finite, boundless three-dimensional Hypersphere that constitutes the surface of a four-dimensional Nucleus. The Nucleus expands along the fourth spatial dimension, while the observable World is its stretching three-dimensional hyperspherical boundary [1].

Thus, the finite age of the World and the eternal existence of the Universe are not contradictory concepts. They describe two different physical entities.

2.2. The Expanding Four-Dimensional Nucleus

Let R denote the radius of the 4D Nucleus. In WUM, its expansion along the fourth spatial dimension proceeds with the fundamental speed c :

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

where τ is the absolute cosmological time.

WUM introduces the fundamental length a and the corresponding fundamental time

$$t_0 = a/c$$

The fundamental length a is extremely small compared with the present radius R of the World. With the corresponding choice of the cosmological time origin, the radius and cosmological time are related by

$$R = c\tau$$

The fundamental scales a and t_0 are extrapolated quantities and do not themselves mark the physical emergence of the Cosmic Medium.

The expansion of the World is therefore not interpreted as an expansion of three-dimensional space into itself. It is the geometrical consequence of the expansion of the 4D Nucleus along the fourth spatial dimension.

Throughout this evolution, the three-dimensional World remains the hyperspherical surface of the expanding Nucleus and stretches as the radius of the Nucleus increases. Within WUM, Dark Energy is not required to drive the expansion of the World.

This construction gives direct physical meaning to the cosmological expansion speed c .

2.3. Cosmological Time and the World Parameter

The evolution of the World is expressed through the dimensionless **World Parameter Q** :

$$Q = R/a$$

Since R increases continuously, Q provides a natural dimensionless measure of the cosmological evolution of the World.

The enormous present value of Q expresses the separation between the fundamental length scale a and the present cosmological scale R .

Within WUM, many Primary Cosmological Parameters are functions of Q . The evolution of the World is therefore described not by a collection of unrelated cosmological quantities, but by interconnected parameters governed by a common dimensionless measure of cosmological evolution [1– 5].

The World Parameter Q is an evolving quantity and must be distinguished from the **Universe Constant K_U** , which is introduced later as a fundamental constant of the Model.

2.4. Expansion and Continuous Creation of Matter

In WUM, the expansion of the World and the continuous creation of Matter are parts of the same fundamental physical process. Matter is generated through a process analogous to **sublimation**, in which surface formation is energetically favored.

Universe-Created Matter is continuously generated by the Eternal Universe within the expanding four-dimensional Nucleus through the formation of Universe-Created Particles (UCPs). The annihilation and transformation processes of UCPs in the World subsequently give rise to Ordinary Matter [1,5].

This fundamental process connects cosmic expansion, continuous Matter creation, and the arrow of Time.

The generation of UCM proceeds homogeneously throughout the Hypersphere and does not require the prior existence of the Cosmic Medium.

2.5. From Universe-Created Matter to Ordinary Matter

Universe-Created Matter and Ordinary Matter are not identical.

Universe-Created Particles constitute the form in which UCM is generated by the Eternal Universe. Ordinary Particles arise subsequently through physical processes involving UCPs, particularly their interactions and pair annihilation processes.

In WUM, therefore, the Eternal Universe continuously generates Universe-Created Matter within the expanding 4D Nucleus. UCM appears in the form of Universe-Created Particles. Interactions and annihilation processes involving these particles subsequently provide pathways for the generation of Ordinary Particles and, ultimately, Ordinary Matter.

This physical sequence provides the WUM answer to the chicken-and-egg problem introduced in Section 1.

Matter does not need to be postulated as a complete primordial inventory whose origin lies outside the physical description. Instead, the generation of Matter is incorporated into the continuing evolution of the World.

The distinction among UCM, the Cosmic Medium, and Ordinary Matter will become especially important when the physical Medium and the internal structure and evolution of Macroobjects are considered later in this paper.

2.6. Why the Fourth Spatial Dimension Matters

The fourth spatial dimension in WUM is not introduced merely as a mathematical device for describing cosmological geometry. It has direct physical significance for the properties of particles.

A UCP is created within the four-spatial-dimensional structure of the Nucleus. Its momentum must therefore be considered as a **four-spatial-momentum**, rather than being restricted to the three spatial components observed directly within the World.

The component associated with the fourth spatial dimension is particularly important. In WUM,

$$p_4 = E/c$$

where E/c is a real component of the particle's four-spatial-momentum directed along the fourth spatial dimension, and E is the particle's **rest energy**.

This interpretation provides the physical connection between the cosmological geometry of WUM and the microscopic properties of Universe-Created Particles.

The expanding 4D Nucleus therefore has two inseparable roles. It defines the global geometry and cosmological evolution of the World, and it provides the four-spatial-dimensional physical framework within which UCPs are created and acquire their fundamental properties.

The four-spatial-momentum and its relationship to UCP rest energy are considered in detail in the following section.

3. Fundamental Nature of Universe-Created Particles

Universe-Created Particles are the fundamental constituents of Universe-Created Matter.

Their proposed physical nature follows from the four-spatial-dimensional structure of WUM and differs conceptually from descriptions based on three directly observable spatial dimensions.

The essential starting point is that a particle created within the expanding 4D Nucleus must be described by momentum having four spatial components.

3.1. Four-Spatial-Momentum

In ordinary three-dimensional space, the momentum of a particle is represented by three spatial components:

$$\mathbf{p}_3 = (p_x, p_y, p_z)$$

In WUM, the physical structure of the Nucleus contains a fourth spatial dimension. The momentum of a UCP must therefore possess an additional real spatial component. Its four-spatial-momentum is represented by

$$\mathbf{P}_4 = (p_x, p_y, p_z, p_4)$$

where the fourth component is directed along the fourth spatial dimension.

In WUM,

$$p_4 = \frac{E}{c}$$

where E is the **rest energy** of the particle and c is the speed of expansion of the 4D Nucleus along the fourth spatial dimension.

The four-spatial-momentum can therefore be written as

$$\mathbf{P}_4 = (p_x, p_y, p_z, \frac{E}{c})$$

The quantity E/c is not introduced as a formal mathematical component. In WUM, it represents a real momentum component along the fourth spatial dimension [1].

This interpretation is central to the physical description of Universe-Created Particles.

3.2. Rest Energy as a Fundamental Particle Property

Within WUM, particles are characterized by their **rest energies**.

Because the fourth spatial momentum component is

$$p_4 = \frac{E}{c}$$

the rest energy can equivalently be written as

$$E = cp_4$$

The rest energy is therefore directly associated with the particle's momentum structure in four-spatial-dimensional space.

The speed c has a correspondingly fundamental meaning. It characterizes the expansion of the Nucleus along the fourth spatial dimension and connects a particle's rest energy with its fourth spatial momentum component.

This interpretation is especially important for the present work because WUM predicts a **discrete spectrum of UCP rest energies** [1,5]. These rest energies provide quantitative signatures that can be compared with astronomical and experimental observations.

3.3. Creation of UCPs in the Expanding Nucleus

As discussed in Section 2, the Eternal Universe continuously generates Universe-Created Matter within the expanding 4D Nucleus.

Universe-Created Matter appears in the form of UCPs. Their creation is therefore intrinsically connected with the fourth spatial dimension. Newly formed UCPs possess four-spatial-momentum, including the component E/c directed along the fourth spatial dimension.

The expansion of the Nucleus and the generation of UCPs are thus two aspects of the same cosmological framework. The macroscopic evolution of the World and the microscopic properties of Universe-Created Matter originate within a common four-spatial-dimensional physical structure.

This connection is one of the central features of WUM. Cosmology and particle physics are not treated as independent subjects linked only through initial conditions. The same cosmological framework that describes the evolution of the World also establishes characteristic properties of Universe-Created Matter.

3.4. UCPs as a Multicomponent System

Universe-Created Matter is not proposed to consist of a single particle species.

WUM predicts a **multicomponent system of UCPs with definite rest energies**. Different UCP species occupy different positions in the energy hierarchy and perform different physical roles in the evolution of the World.

Some UCPs form couples whose rest energies are related through the Universe Constant K_U . These couples are especially important observationally because evidence for both theoretically related members would provide a stronger test than correspondence with the rest energy of an isolated particle [1,5].

Other UCPs are not members of such couples but nevertheless possess theoretically specified rest energies and proposed physical manifestations.

The existence of a structured particle spectrum is crucial for falsifiability. If UCPs could possess arbitrary rest energies, unexplained astronomical phenomena could be associated retrospectively with the Model. A discrete and theoretically constrained spectrum imposes a much stronger requirement.

Nature must reproduce the predicted structure.

3.5. UCP Ensembles and Intrinsic Angular Momentum

The physical importance of UCPs extends beyond their rest energies.

A fundamental property of Universe-Created Matter in WUM is its connection with **angular momentum**.

Ensembles of UCPs carry intrinsic angular momentum, physically resembling microscopic “air vortices.”

The air-vortex analogy is intended as a physical visualization rather than an identification of UCP ensembles with ordinary fluid vortices. A vortex possesses organized rotational motion and therefore carries angular momentum. Similarly, ensembles of UCPs are conceived in WUM as possessing intrinsic rotational organization associated with their formation and four-spatial-dimensional dynamics.

This property becomes particularly important when UCPs form the internal components of Macroobjects. In conventional astrophysical descriptions, the angular momentum of astronomical systems is generally explained through their dynamical history, including tidal torques, accretion, interactions, mergers, and related processes.

If Macroobjects form from ensembles of UCPs already carrying intrinsic angular momentum, then angular momentum is present from the beginning of Macroobject formation. Subsequent dynamical evolution can redistribute, amplify, or transfer it, but its fundamental origin does not have to be sought exclusively in later interactions among initially nonrotating systems.

This concept provides the foundation for the WUM explanation of the rotation and rotational evolution of Macroobjects, including the proposed **Rotational Fission** of overspinning UCM Cores involved in the formation of galaxies and extrasolar systems [4,5].

3.6. Two Fundamental Consequences of UCP Creation

The continuous creation of UCPs has two fundamental physical consequences.

First, it provides a proposed mechanism for the **origin and continuing generation of Matter** in the World.

Second, because ensembles of UCPs carry intrinsic angular momentum, it provides a proposed physical foundation for the **origin of angular momentum** in cosmic structures.

Matter and angular momentum are therefore not treated in WUM as two unrelated cosmological ingredients requiring separate origins. Both arise from the continuous generation of Universe-Created Particles by the Eternal Universe within the expanding 4D Nucleus.

This common origin connects the material content of the World with the rotational properties of the structures that subsequently form from it.

3.7. From Fundamental Principles to Quantitative Predictions

A physical concept becomes scientifically consequential when it leads to quantitative predictions.

The four-spatial-dimensional description establishes the proposed physical nature of UCPs, but it does not by itself specify their complete spectrum of rest energies. For this purpose, WUM employs a small set of fundamental quantities that connect microscopic particle scales with the cosmological structure of the World.

Particularly important are the **Universe Constant K_U** , the **World Parameter Q** , the fundamental length a , and the expansion speed c .

The Universe Constant K_U is a fixed quantity, whereas the World Parameter Q evolves with cosmological time. This distinction is fundamental and will be maintained throughout the paper [1,5].

Together, these quantities provide the basis for the quantitative UCP rest-energy spectrum that will ultimately be confronted with astronomical and experimental observations.

The next section introduces these quantities and their physical roles in WUM.

4. Fundamental Quantities of WUM

A central objective of WUM is to describe cosmological and microscopic phenomena through a small number of interconnected fundamental quantities. This approach is especially important for the UCP hypothesis.

If the rest energies of Universe-Created Particles were independent adjustable parameters, correspondence with observed astronomical features would have limited evidentiary value. The situation is substantially different if these rest energies arise from a common theoretical framework.

For the present discussion, the most important quantities are the **Universe Constant K_U** , the **World Parameter Q** , the fundamental length a , and the speed c of expansion of the 4D Nucleus along the fourth spatial dimension. Together, these quantities connect the microscopic rest-energy scales of UCPs with the macroscopic evolution of the World.

4.1. Universe Constant K_U

WUM 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:

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

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

The Universe Constant K_U is a fixed dimensionless quantity. Its numerical value corresponds to the fine-structure constant α .

The Universe Constant K_U and the World Parameter Q have fundamentally different physical meanings. K_U is fixed, whereas Q changes with cosmological time.

$$Q = Q(\tau)$$

Where inverse-square combinations of the Universe Constant are required, the notation

$$K_U^{-2}$$

will be used.

The distinction between K_U and Q allows WUM to separate permanent dimensionless relationships from quantities that describe the continuing evolution of the World.

4.2. World Parameter Q

The dimensionless World Parameter is defined as

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

where R is the radius of the expanding 4D Nucleus and a is the fundamental length of WUM.

Since

$$R = c\tau$$

and

$$t_0 = a/c$$

the World Parameter can also be written as

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

The World Parameter therefore provides a dimensionless measure of both the size and cosmological age of the World.

Its importance extends considerably further. In WUM, many Primary Cosmological Parameters are interconnected through Q . The characteristic properties of the World are therefore not treated as a collection of mutually independent observational quantities, but as related functions of a common evolutionary parameter [1,5].

4.3. Fundamental Length a

The quantity a establishes the fundamental length scale of WUM. Its value is approximately

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

The radius of the 4D Nucleus is related to a and Q by

$$R = aQ$$

The very large present size of the World can therefore be expressed through a microscopic fundamental length multiplied by the enormous dimensionless World Parameter.

The same fundamental length defines the characteristic time

$$t_0 = a/c$$

with the approximate value

$$t_0 = 5.9059662 \times 10^{-23} \text{ s}$$

Thus, a and t_0 provide the fundamental length and time scales of WUM.

These quantities should not, however, be interpreted as marking the physical beginning of the Cosmic Medium. They are fundamental scales that can be extrapolated within the mathematical relationships of the Model. As discussed in Section 8, **the Cosmic Medium emerges physically later, with the appearance of Universe-Created Fermion UCF1.**

Most importantly for the present paper, the fundamental length also defines a characteristic rest-energy scale:

$$E_0 = hc/a$$

where h is Planck's constant.

Numerically,

$$E_0 = 70.025267 \text{ MeV}$$

4.4. The Fundamental Rest-Energy Scale E_0

The relation

$$E_0 = hc/a$$

provides a direct connection between the fundamental geometrical scale of WUM and its particle physics.

Through Planck's constant h and the expansion speed c , the fundamental length a corresponds to a characteristic rest energy of approximately 70.025 MeV.

This numerical value is not introduced by fitting an observed gamma-ray feature. It follows from the fundamental length scale of the Model.

WUM associates this characteristic rest energy with DIRAC, whose rest energy directly equals the fundamental rest-energy scale E_0 [1,5].

DIRAC and the observational consequences of its predicted rest energy are considered in Section 5.

4.5. Fundamental Meaning of c

In WUM, the speed c has a broader physical interpretation than its familiar role in electromagnetic phenomena.

The 4D Nucleus expands along the fourth spatial dimension according to

$$dR/d\tau = c$$

Thus, c is fundamentally the **speed of expansion of the Nucleus along the fourth spatial dimension**.

The same quantity enters the microscopic description of UCPs through

$$p_4 = E/c$$

where the fourth spatial momentum component is directed along the fourth spatial dimension, and through the fundamental rest-energy scale

$$E_0 = hc/a$$

The occurrence of the same quantity c in cosmological expansion, four-spatial-momentum, and the fundamental UCP rest-energy scale is an important structural feature of WUM. It connects the global evolution of the World with the microscopic properties of Universe-Created Particles.

4.6. From One Rest-Energy Scale to a Particle Spectrum

The approximately 70-MeV rest-energy scale is only the starting point of the UCP system.

WUM proposes a discrete spectrum of Universe-Created Particles whose rest energies span many orders of magnitude. These values are not regarded as unrelated numbers independently assigned to different particles. They arise within one theoretical framework and are connected through the fundamental quantities and dimensionless relationships of the Model.

This distinction is essential for the observational argument of the present paper.

A model constructed after observations by introducing a different particle for every unexplained astronomical feature would have limited predictive significance. A stronger test is possible when the particle spectrum is specified theoretically and subsequently compared with independent observations.

The relevant question is therefore not simply whether astronomical spectra contain features near selected energies. It is whether a **theoretically interconnected and independently specified spectrum of UCP rest energies** has quantitative counterparts in Nature [1,5].

This requirement becomes still more restrictive for UCP couples because both theoretically related rest energies should have corresponding physical manifestations.

4.7. The First Quantitative Test

DIRAC provides the natural starting point for testing the UCP hypothesis because its characteristic rest energy follows directly from the fundamental scale

$$E_0 = hc/a = 70.025267 \text{ MeV}$$

An independently observed phenomenon near this characteristic energy can therefore provide a possible connection between the fundamental geometrical scale of WUM and the predicted UCP spectrum.

An energy correspondence alone, however, cannot establish particle identity. The observed spectral structure, measurement uncertainties, competing physical mechanisms, astrophysical environment, and additional consequences predicted for DIRAC must also be considered.

DIRAC therefore provides both the first member of the UCP spectrum to be examined and the first example of the evidentiary standard applied throughout this paper.

The next section considers **DIRAC: the Primary Universe-Created Particle**.

5. DIRAC and the Neutral-Pion Background

Among the Universe-Created Particles proposed by WUM, DIRAC provides a particularly important observational test because its predicted rest energy lies close to the characteristic photon-energy scale associated with neutral-pion decay.

This proximity creates both an observational difficulty and a potentially discriminating quantitative test.

5.1. DIRAC

Within WUM, DIRAC is a light spin-0 boson with predicted rest energy

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

DIRAC is proposed to be a dipole composed of Dirac magnetic monopoles. It belongs to the theoretically predicted UCP system and is the light member of the UCF1–DIRAC couple.

The heavy component of this couple is UCF1, with rest energy approximately

$$E_{UCF1} \sim 1.3 \text{ TeV}$$

The two rest energies are not independent parameters. Within WUM, the DIRAC rest energy is calculated from the UCF1 rest energy through the Universe Constant K_U :

$$E_{DIRAC} = K_U^2 E_{UCF1}$$

Thus, the approximately 70-MeV scale is a theoretical consequence of the UCP construction rather than an energy selected retrospectively from an observed gamma-ray spectrum [1,3].

5.2. Proposed DIRAC Gamma-Ray Signature

If DIRAC particles undergo pair annihilation and a symmetric two-photon final state is produced with negligible center-of-momentum motion, the characteristic photon energy is expected to be associated with the DIRAC rest-energy scale:

$$E_{gamma} \sim E_{DIRAC} \sim 70.025 \text{ MeV}$$

In an astrophysical environment, however, the annihilating particles need not be at rest with respect to the observer. Their velocity distribution and the motion of the emitting region can broaden and shift the observed radiation.

Consequently, the observational signature of DIRAC should not necessarily be expected to appear as an infinitely narrow gamma-ray line at exactly 70.025 MeV. The appropriate test is a quantitative search for an additional spectral component associated with this theoretically predicted energy scale.

5.3. Neutral-Pion Decay

The principal conventional background in this energy region is gamma-ray emission produced by neutral-pion decay:

$$\pi^0 \rightarrow \text{gamma} + \text{gamma}$$

The neutral pion has rest energy approximately

$$E_{\pi^0} \sim 134.98 \text{ MeV}$$

For a neutral pion at rest, conservation of energy and momentum gives two photons of equal energy:

$$E_{\text{gamma}} \sim E_{\pi^0}/2 \sim 67.49 \text{ MeV}$$

Neutral-pion decay is experimentally well established and constitutes an important mechanism of astrophysical gamma-ray production [8,9].

The two characteristic energy scales are therefore

$$E_{\text{gamma},\pi^0} \sim 67.49 \text{ MeV}$$

and

$$E_{\text{DIRAC}} \sim 70.025 \text{ MeV}$$

Their separation is

$$\Delta E \sim 2.54 \text{ MeV}$$

corresponding to approximately 3.8%.

This small but definite difference provides a quantitative basis for distinguishing the two proposed contributions. In realistic astrophysical environments, however, the observational distinction is substantially more complicated because neutral pions are not generally at rest.

5.4. Distinguishing DIRAC from Neutral-Pion Decay

Neutral-pion decay is a well-established physical process:

$$\pi^0 \rightarrow \text{gamma} + \text{gamma}$$

For a neutral pion at rest, the two photons have energies of approximately

$$E_{\text{gamma}} \sim 67.49 \text{ MeV}$$

In astrophysical environments, neutral pions are produced with distributions of energies and momenta. Their decay therefore generates a broad gamma-ray spectrum rather than a narrow line at 67.49 MeV. The characteristic spectral structure associated with this process is commonly referred to as the **pion bump** [9].

Fermi-LAT observations of the supernova remnants IC 443 and W44 have provided strong evidence for such a pion-decay spectral signature [9]. These observations support the presence of hadronic processes and neutral-pion production in these sources.

They do not, however, imply that every gamma-ray contribution in the approximately 70-MeV region must necessarily originate from neutral-pion decay.

This distinction is particularly important for WUM because the independently predicted DIRAC rest energy,

$$E_{\text{DIRAC}} \sim 70.025 \text{ MeV}$$

lies close to the characteristic neutral-pion photon-energy scale

$$E_{\text{gamma},\pi^0} \sim 67.49 \text{ MeV}$$

The difference is only approximately 2.54 MeV, or 3.8%.

Because astrophysical pion decay produces a broad spectrum, while realistic DIRAC annihilation may also produce a broadened spectral component, **gamma-ray energy alone may be insufficient to distinguish reliably between the two contributions.**

An additional observational connection arises from the Galactic 511-keV emission. In 2003, J. Knödseder, *et al.* [10] and P. Jean *et al.* [11] reported observations with the SPI spectrometer aboard INTEGRAL of 511-keV gamma-ray emission from the Galactic bulge.

In related work, C. Boehm and collaborators investigated whether annihilation of light Dark Matter particles in the MeV energy domain could contribute to the Galactic 511-keV emission [12].

These studies are relevant to WUM because the predicted DIRAC rest energy lies in the MeV domain independently investigated in connection with Galactic positron production.

The connection is particularly interesting because DIRAC processes are proposed within WUM to generate **Dirac magnetic monopoles together with electrons and positrons.** The production of positrons therefore provides a possible physical connection between DIRAC processes and the observed Galactic 511-keV annihilation radiation.

This correspondence does not by itself establish the existence of DIRAC. It provides an additional and physically distinct observational test beyond the approximately 70-MeV gamma-ray domain.

5.5. Energy Correspondence Is Not the Decisive Test

The proximity of the DIRAC and neutral-pion energy scales creates a significant observational challenge in distinguishing the two contributions.

A broad gamma-ray feature in the approximately 70-MeV domain cannot, by itself, establish a DIRAC contribution. Its physical interpretation requires information beyond photon energy alone.

For this reason, WUM does not rely on the approximately 70-MeV correspondence as an isolated proof of DIRAC.

DIRAC belongs to a theoretically predetermined UCP system. In particular,

$$E_{\text{DIRAC}} = K_U^2 E_{\text{UCF1}}$$

where

$$E_{\text{UCF1}} \sim 1.3 \text{ TeV}$$

The more restrictive test is therefore whether a phenomenon associated with the approximately 70-MeV scale occurs as part of the broader physical pattern predicted for the UCF1–DIRAC couple.

5.6. Testing DIRAC as Part of a UCP Couple

If the pion and DIRAC contributions cannot be separated reliably through gamma-ray energy alone, discrimination must come from their different physical contexts and predicted relationships.

The neutral-pion interpretation associates the gamma-ray emission with hadronic interactions that produce neutral pions followed by their decay.

The WUM interpretation associates a DIRAC contribution with Universe-Created Matter and, more specifically, with the theoretically related UCF1–DIRAC couple.

Within WUM,

$$E_{DIRAC} = K_U^2 E_{UCF1}$$

with

$$E_{UCF1} \sim 1.3 \text{ TeV}$$

Evidence for a DIRAC-related component near the predicted 70.025-MeV scale would therefore become substantially more significant if the same or physically connected astrophysical environment also exhibited evidence associated with the theoretically related UCF1 component near 1.3 TeV.

The test is still more restrictive because DIRAC processes are proposed within WUM to generate Dirac magnetic monopoles together with electrons and positrons, while UCF1 processes are proposed to participate in the generation of protons and electrons.

Thus, the approximately 70-MeV radiation should not be regarded as an independent proof of DIRAC. Nor should its location within the broad pion-decay energy domain automatically exclude a possible DIRAC contribution.

The strongest test is the simultaneous consistency of the predicted DIRAC rest-energy scale, the UCF1–DIRAC relationship, the astrophysical environment, and the associated particle products.

The approximately 70-MeV correspondence is therefore one component of the test, but **the UCF1–DIRAC couple is the more fundamental prediction.**

5.7. Falsifiability

The proximity of the DIRAC scale to the experimentally established pion-decay spectrum makes this prediction particularly vulnerable to observational testing.

If increasingly precise measurements of appropriate UCM-rich environments are quantitatively explained by neutral-pion decay and other established processes, with no statistically significant additional component compatible with the predicted DIRAC contribution, the observational case for DIRAC would be constrained.

Conversely, a reproducible additional component associated with the predicted 70.025-MeV scale, particularly if accompanied by evidence for the theoretically related UCF1 component and the proposed particle products, would provide a substantially stronger test of the WUM hypothesis than an isolated gamma-ray energy correspondence.

The DIRAC hypothesis must therefore be tested **against the complete experimentally established pion-decay spectrum, not against an idealized 67.49-MeV line.**

The next section presents the **complete UCP system.**

5.8. DIRAC and ELOP in Electromagnetism

Within WUM, DIRACs are conceived as magnetic dipoles composed of Dirac magnetic monopoles of opposite magnetic charge. Consequently, DIRACs possess a magnetic dipole moment related to the Bohr magneton. A local concentration of DIRACs within the Matter-filled Cosmic Medium can therefore produce both a magnetization **M** and a corresponding magnetic field intensity **H** [13].

According to the **Dirac quantization condition**:

$$\frac{q_e q_m}{\epsilon_0 \hbar c^2} \in \mathbb{Z}$$

where q_e is the electric charge, q_m is the magnetic charge, ϵ_0 is the electric constant, $\hbar$ is Planck's constant, and $\mathbb{Z}$ denotes integers,

The fundamental magnetic charge is [14]:

$$q_m = \mu c$$

where

$$\mu = \frac{e}{2} K_U^{-1}$$

The magnetic dipole moment of a DIRAC is

$$\mu_{DIRAC} = \mu c \times a$$

where the distance between the magnetic charges is

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

For a concentration of DIRACs (n_{DIRAC}), the resulting magnetization (**M**) is:

$$\mathbf{M} = n_{DIRAC} \times \mu_{DIRAC}$$

For comparison, the magnetization of the strongest neodymium magnets, with a characteristic Fe–Fe distance of approximately 0.25 nm, is

$$\mathbf{M} \sim 10^6 \text{ Am}^{-1}$$

Using this magnetization as a characteristic comparison scale, the calculated DIRAC concentration is

$$n_{DIRAC} \sim 1.7 \times 10^{28} \text{ m}^{-3}$$

corresponding to an average DIRAC–DIRAC separation of approximately 0.39 nm. This value is of the same order as the characteristic Fe–Fe separation in neodymium magnets.

Within WUM, this comparison motivates a different microscopic interpretation of magnetization. **WUM replaces the mathematical magnetic-pole representation of a dipole with the DIRAC magnetic-dipole model**, in which magnetic dipoles are physical objects composed of Dirac magnetic monopoles.

A corresponding microscopic construction is proposed for electric polarization.

In classical electromagnetism, polarization (**P**) represents the macroscopically averaged electric dipole moment per unit volume. Within WUM, ELOPs are conceived as electric dipoles ($\mathbf{d}_{ELOOP}$) composed of preons carrying charges $e/3$ and separated by a characteristic distance a . For an ELOP concentration (n_{ELOOP}), the resulting polarization is

$$\mathbf{P} = n_{ELOOP} \times \mathbf{d}_{ELOOP}$$

Thus, DIRACs and ELOPs provide proposed microscopic physical constituents associated respectively with the **magnetic and electric responses of the Cosmic Medium**. DIRAC magnetic dipoles provide the microscopic basis for magnetization **M**, while ELOP electric dipoles provide the microscopic basis for polarization **P**.

Within this interpretation, **H** and **D** are not regarded merely as auxiliary mathematical quantities. They represent real field components associated with the physical response of the Matter-filled Cosmic Medium.

Summary

Within WUM, isolated magnetic monopoles are not proposed as constituents of the Cosmic Medium. Instead, Dirac magnetic monopoles occur as constituents of magnetic dipoles—DIRACs. Correspondingly, electrically charged preons occur as constituents of electric dipoles—ELOPs.

The electromagnetic description of propagation through the Cosmic Medium should therefore incorporate the macroscopically averaged polarization $\mathbf{P}$ and magnetization $\mathbf{M}$ produced by its ELOP and DIRAC components. It should also include the corresponding ELOP and DIRAC current densities induced by electromagnetic fields.

This construction provides WUM with a microscopic physical interpretation of the electromagnetic properties of the Cosmic Medium: **ELOPs provide its electric-dipole response, while DIRACs provide its magnetic-dipole response.**

This approach also provides a framework for investigating magnetic phenomena on astrophysical scales, including the proposed **dark magnetic field**, the large-scale magnetic structure of the Milky Way, and other magnetic phenomena that are only partially correlated with objects observed in other spectral ranges.

6. The Complete UCP System

DIRAC is not an isolated hypothetical particle. Within WUM, it belongs to a theoretically interconnected system of **Universe-Created Particles** whose rest energies span many orders of magnitude.

This multicomponent structure is essential to the scientific test developed in the present paper.

If only one new particle were proposed, an astronomical feature occurring near its predicted rest energy might represent either genuine evidence or an accidental numerical correspondence. The evidentiary situation becomes substantially more restrictive when a theoretical framework predicts an entire discrete particle spectrum before comparison with observations.

The fundamental question is therefore not whether one observed feature can be associated with one proposed particle. It is whether Nature reproduces a recognizable **system of predicted rest energies and the physical relationships among them.**

6.1. Structure of the UCP Spectrum

The complete UCP system considered in the present work consists of **seven Universe-Created Particles** [1,5].

These particles include both theoretically related **UCP couples** and particles occupying independently specified positions in the UCP spectrum.

The concept of UCP couples is particularly important. A couple is not defined because two observed spectral features happen to occur in the same astronomical object. The relationship between the two particles arises first from the theoretical structure of WUM. Observations are then used to determine whether Nature exhibits signatures corresponding to both predicted members.

This distinction is fundamental. The theory specifies the particle system before the observational comparison is made. The astronomical data are subsequently examined to determine whether the predicted structure is present in Nature.

This provides a substantially more restrictive test than searching independently for unexplained astronomical features and associating them afterward with proposed particles.

6.2. Rest Energy as the Primary Observational Identifier

Each UCP is characterized first by its theoretically predicted **rest energy**.

Rest energy is particularly useful observationally because annihilation and other processes involving UCPs can produce electromagnetic radiation with characteristic energies related to the UCP rest-energy scale.

In the simplest case of symmetric pair annihilation into two gamma quanta with negligible center-of-momentum motion, each emitted photon can have an energy approximately equal to the rest energy of the annihilating UCP.

This relationship provides one of the principal observational strategies employed in the present work.

An observed photon energy alone, however, does not identify a UCP. A convincing association requires quantitative agreement with the theoretically predicted rest energy, sufficient statistical significance and reproducibility of the observed feature, careful consideration of established physical mechanisms capable of producing the same phenomenon, and consistency with the astrophysical environment in which the corresponding UCP is expected to occur.

An even stronger test becomes possible when additional signatures predicted for the same UCP are observed. For members of a UCP couple, evidence for the predicted partner in the same or a physically related environment is especially important.

The purpose is therefore not merely to identify matching numbers but to test an interconnected physical system.

6.3. Historical Background for Light–Heavy Particle Couples

The concept of simultaneously considering light and heavy components of Dark Matter has an important precedent in the work of Boehm, Fayet, and Silk. Motivated by the Galactic 511-keV emission observed by INTEGRAL/SPI and by possible very-high-energy gamma-ray signatures of Dark Matter annihilation, they proposed that the low- and high-energy phenomena could be accommodated through the existence of two stable neutral Dark Matter particles: a heavy fermionic component and a much lighter spin-0 component [15].

Related work by Boehm and collaborators examined the possibility that MeV-scale Dark Matter annihilation could contribute to the Galactic 511-keV emission [12].

WUM develops a different and more specific construction. It proposes two light–heavy UCP couples:

UCF1 – DIRAC

$$E_{UCF1} \sim 1.3 \text{ TeV} \quad E_{DIRAC} \sim 70.025 \text{ MeV}$$

and

UCF2 –ELOP

$$E_{UCF2} \sim 9.6 \text{ GeV} \quad E_{ELOP} \sim 340 \text{ keV}$$

In WUM, however, the rest energies of the two members of each couple are not independent assignments. The light-component rest energy is calculated from that of the heavy component through the **Universe Constant** K_U :

$$E_{light} = K_U^2 \times E_{heavy}$$

Thus,

$$E_{DIRAC} = K_U^2 \times E_{UCF1}$$

and

$$E_{ELOP} = 2/3 K_U^2 \times E_{UCF2}$$

The work of Boehm, Fayet, Silk, and collaborators therefore provides an important historical precedent for considering light and heavy Dark Matter components together, while WUM proposes specific particle identities, definite rest energies, and a quantitative relationship between the heavy and light members of each UCP couple.

6.4. UCP Couples

WUM proposes UCP couples whose members differ greatly in rest energy but are connected through the Universe Constant K_U .

In each couple considered here, the rest energy of the **light component is calculated from the rest energy of the heavy component** according to

$$E_{light} = K_U^2 \times E_{heavy}$$

For the first high-energy couple,

UCF1 – DIRAC

$$E_{DIRAC} = K_U^2 \times E_{UCF1}$$

with

$$E_{UCF1} \sim 1.3 \text{ TeV} \quad E_{DIRAC} \sim 70.025 \text{ MeV}$$

For the second high-energy couple,

UCF2 –ELOP

$$E_{ELOP} = 2/3 K_U^2 \times E_{UCF2}$$

with

$$E_{UCF2} \sim 9.6 \text{ GeV} \quad E_{ELOP} \sim 340 \text{ keV}$$

Thus, the light-particle rest energies are theoretical consequences of the corresponding heavy-particle rest energies and of the fixed Universe Constant K_U . The UCP couples are specified before comparison with astronomical observations.

This provides a substantially more restrictive test than treating the four energy scales independently. Observations must determine whether Nature reproduces not only the individual predicted energies but also the coupled structure from which the light components are derived.

These pairings are not inferred from similarities among observed astronomical spectra. They belong to the theoretical UCP construction of WUM and are specified independently of the observational evidence considered in this paper. Observations are therefore used to **test the theoretically predicted couples, not to define them.**

6.5. The 1.3-TeV–70-MeV Couple

The first high-energy UCP couple consists of the heavy fermionic UCF1 and the light spin-0 boson DIRAC.

Their characteristic rest energies are approximately 1.3 TeV and 70.025 MeV, respectively.

The two members occupy very different energy regimes. Consequently, observational evidence for the couple must connect phenomena separated by more than four orders of magnitude in energy.

This large separation provides a demanding test of the hypothesis. The evidentiary significance would be substantially increased if independently measured phenomena near both predicted energy scales were found to possess the spatial, spectral, or physical relationships expected for members of the same UCP couple.

The observational status of this couple is therefore examined through measurements extending from the MeV domain to the TeV domain.

The test is strengthened further by the physical products attributed to the two particles. Within WUM, UCF1 annihilation is proposed to participate in the generation of protons and electrons, while DIRAC processes are proposed to participate in the generation of Dirac magnetic monopoles, electrons, and positrons.

The UCF1–DIRAC hypothesis consequently predicts more than two energy scales. It connects those scales with specific particle-production processes.

6.6. The 9.6-GeV–340-keV Couple

The second high-energy UCP couple consists of UCF2 and ELOP.

Their characteristic rest energies are approximately 9.6 GeV and 340 keV, respectively.

Within WUM, ELOP is a spin-0 boson conceived as a dipole composed of preons carrying fractional electric charge $e/3$. These preons are proposed to participate in the formation of atomic nuclei.

If a single ELOP undergoes a two-photon decay in which its rest energy is shared symmetrically, the characteristic photon energy would be approximately 170 keV.

The observational test of this couple is particularly attractive because both energy regions are accessible to astronomical observations of energetic environments. Gamma-ray observations of the Galactic Center, the Fermi Bubbles, and other high-energy structures extend through the GeV domain, while hard-X-ray and soft-gamma-ray measurements probe the hundreds-of-keV region.

The important question is not simply whether emission has been observed somewhere near the predicted UCF2 scale of 9.6 GeV and within the ELOP-related 340-keV and 170-keV domains. The stronger test is whether phenomena associated with these characteristic energy scales exhibit the spectral, spatial, and astrophysical relationships expected for the theoretically predicted UCF2–ELOP couple.

The Galactic Center and the Fermi Bubbles are therefore particularly important environments for testing this relationship.

The 170-keV Galactic-Center Feature

An additional observational energy scale of interest is the approximately 170-keV gamma-ray feature reported from the direction of the Galactic Center [16].

Lingenfelter and Hua analyzed this feature and showed that Compton scattering of 511-keV electron-positron annihilation photons can produce a line-like reflection feature near 170 keV through backscattering. They proposed this mechanism as an explanation for the approximately 170-keV emission observed together with 511-keV annihilation radiation from the Galactic-Center direction [16].

Subsequent searches did not consistently reproduce this feature, indicating that the reported approximately 170-keV emission, if astrophysical, may be transient.

The approximately 170-keV energy is numerically close to one-half of the predicted ELOP rest-energy scale:

$$E_{ELOP} \sim 340 \text{ keV}$$

and therefore

$$E_{\gamma} \sim 1/2 E_{ELOP} \sim 170 \text{ keV}$$

This numerical relationship is noteworthy, but it should not be identified with the ordinary symmetric two-photon annihilation signature of an ELOP pair, for which each photon would instead carry energy near the ELOP rest-energy scale.

The 170-keV correspondence should therefore be treated as a **separate possible ELOP-related observational clue whose physical mechanism within WUM requires further specification**.

The conventional Compton-backscattering mechanism provides a quantitative explanation for a feature near this energy and must remain part of any comparison.

The principal quantitative ELOP test in the present paper consequently remains the predicted approximately 340-keV rest-energy scale and its relationship to the UCF2 partner near 9.6 GeV.

6.7. Complete Spectrum as the Critical Test

The two high-energy couples represent only part of the UCP system.

The complete WUM hypothesis considered in this paper contains **seven Universe-Created Particles** extending from the XION radio-frequency energy domain to the TeV domain [1,5]. Their predicted rest energies and principal observational tests are summarized in **Table 1**.

Table 1. Universe-Created Particles and Their Principal Observational Tests.

WUM Particle	Predicted Rest Energy	Principal Observational Test
UCF1	1.3 TeV	TeV cosmic-ray and gamma-ray observations
UCF2	9.6 GeV	Galactic Center, M31, and Fermi Bubbles
DIRAC	70.025 MeV	Gamma-ray observations near the predicted DIRAC scale and distinction from the broad neutral-pion contribution
ELOP	340 keV	340-keV rest-energy domain and possible 170-keV two-photon signature
UCF3	3.7 keV	X-ray observations
UCF4	0.2 eV	Infrared spectral observations
XION	μeV -scale	Radio-frequency phenomena and proposed role in Gravitation

The predicted UCP spectrum extends across an exceptionally broad range of rest energies, from the XION radio-frequency domain to the TeV domain. This enormous range is itself important to the observational test because the proposed signatures occur in fundamentally different observational domains and are measured with different instruments and techniques.

The seven predicted rest energies must therefore be considered collectively rather than as seven opportunities to find approximate numerical matches.

The observational problem is to determine whether Nature contains phenomena that correspond quantitatively and physically to the predicted UCP spectrum. The evidentiary strength increases when several

predicted energy scales are independently observed in appropriate astrophysical environments. It increases further when the predicted relationships between coupled particles and their proposed physical products are also reproduced.

The strongest evidence would therefore not consist of an especially convincing correspondence for one selected UCP. It would consist of multiple independent correspondences that collectively reproduce the structure of the theoretically predicted seven-particle system.

This is the principal quantitative challenge undertaken in the remainder of the paper.

7. Physical Roles of Universe-Created Matter

The preceding sections developed the UCP spectrum from the fundamental principles of WUM and considered the physical relationships among its constituent particles. We now turn from the properties of individual UCPs to the physical system that they collectively constitute—**Universe-Created Matter**.

Within WUM, Universe-Created Matter is not introduced merely as invisible Matter required to reproduce gravitational effects, nor is the generation of Ordinary Matter its only purpose. UCM is the dominant physical component of the World and undergoes its own continuing evolution.

At the present cosmological epoch, UCM constitutes approximately **92.8% of the total energy density of the World** [1,5]. Thus, according to WUM, most of the physical content of the World resides in Universe-Created Matter.

UCM is continuously generated by the Eternal Universe within the expanding four-dimensional Nucleus through the formation of Universe-Created Particles.

These particles constitute the UCM component of the Cosmic Medium, form Cores and shells of Macroobjects, carry intrinsic angular momentum, participate in Rotational Fission, supply UCP Annihilation Reactors (UARs), produce radiation and energetic particles through their interactions and annihilation, and participate through specific processes in the generation of Ordinary Matter.

The physical role of UCM is therefore considerably broader than that conventionally assigned to dark matter. In WUM, UCM is an active and evolving component of the Cosmos.

7.1. UCM Cores and Continuing Formation of Cosmic Structures

In WUM, Universe-Created Matter provides the fundamental material from which the Cores of Macroobjects are formed.

During the evolution of the World, new UCM Cores of Superclusters continue to form. These Cores subsequently evolve and can give rise to new astronomical systems. The process is hierarchical: Supercluster Cores are associated with the formation of Galactic Cores, Galactic Cores with the formation and evolution of stellar systems, and UCM Cores are present in gravitationally rounded Macroobjects at successive levels of this hierarchy.

Structure formation is therefore not restricted to a single early cosmological epoch. It is a continuing physical process associated with the continuing generation and evolution of Universe-Created Matter.

Within this picture, new Superclusters can form during the evolution of the World, existing structures can continue to develop, new galaxies and stars can arise, and gravitationally rounded Macroobjects can undergo continuing internal evolution.

This continuing formation is an important consequence of the fundamental WUM proposition that UCM itself continues to be generated by the Eternal Universe.

7.2. Angular Momentum and Rotational Fission

Angular momentum plays a fundamental role in the evolution of UCM structures.

Ensembles of UCPs carry intrinsic angular momentum, physically resembling microscopic “air vortices.” Consequently, UCM Cores possess angular momentum as an inherent physical property of the Matter from which they are formed.

As a UCM Core grows and evolves, its rotational state can change until it becomes overspinning. WUM proposes **Rotational Fission** as a mechanism by which such a Core can produce daughter UCM Cores while redistributing angular momentum [1,5].

This mechanism plays an important role in the hierarchical formation of astronomical systems in WUM. Overspinning Supercluster Cores can undergo Rotational Fission and produce Galactic Cores. The subsequent evolution and Rotational Fission of these structures can produce further generations of astronomical systems.

In particular, WUM proposes that **Luminous Galaxies and Extrasolar Systems arise through Rotational Fission of overspinning UCM Cores** [1,5]. Their formation and angular momentum are therefore not treated as unrelated problems. Both are consequences of the physical properties and rotational evolution of Universe-Created Matter.

Rotational Fission also provides a mechanism for transferring angular momentum from parent Cores to daughter systems. The observed rotation of astronomical structures is thus connected, within WUM, to the intrinsic angular momentum carried by the UCP ensembles from which their Cores are formed.

7.3. UCM Cores as Gravitating Objects

UCM Cores are not expected to be observed through ordinary electromagnetic radiation in the same manner as luminous Matter. Their existence can nevertheless be investigated through their gravitational influence and through physical phenomena associated with the UCPs they contain.

Orbital dynamics and gravitational lensing provide important means of detecting gravitating Matter independently of its luminosity. WUM interprets compact concentrations of nonluminous gravitating Matter in galaxies and other astronomical systems as possible manifestations of UCM Cores.

Gravitational evidence alone, however, cannot uniquely identify such an object as a UCM Core because other physical interpretations may produce similar gravitational effects.

A stronger observational test becomes possible when gravitational evidence is accompanied by particle-specific signatures predicted for UCPs. If a nonluminous gravitating concentration is found in an astrophysical environment where radiation corresponding to theoretically predicted UCP rest energies is also observed, the two independent types of evidence can be considered together.

The case becomes stronger still if additional phenomena expected from an active UCM Core are present, including internal energy production, energetic particles, characteristic radiation, or rotational behavior consistent with the WUM description.

The observational test of Universe-Created Matter should therefore not rely on Gravitation alone. It should seek a consistent combination of gravitational effects, predicted UCP signatures, and the physical behavior expected from UCM Cores.

The physical role of UCM, however, extends beyond its concentration in Cores and shells of Macroobjects. A substantial part of UCM constitutes the **Cosmic Medium itself**. The origin, composition, and physical properties of the Cosmic Medium are considered in the following section.

8. Cosmic Medium and the Physical World

The concept of the **Cosmic Medium** occupies a fundamental place in World–Universe Cosmology.

An empty physical World is not the physical arena of WUM; the Cosmic Medium itself is constituted by Matter.

Within WUM, the physical World is not an empty geometrical arena in which Matter is subsequently placed. **Universe-Created Matter provides the primary material basis of the Cosmic Medium, while Ordinary Matter generated from UCM also contributes to its composition.**

The physical properties of the World emerge together with this Matter-filled Medium.

8.1. Physical Definition of the Cosmic Medium

Universe-Created Matter (UCM) denotes the Matter continuously generated by the Eternal Universe in the form of Universe-Created Particles, whereas the **Cosmic Medium (CM)** denotes the physical Matter-filled Medium that emerges with the appearance of UCF1. Thus, UCM denotes Matter of Universe-created origin, while CM describes the physical Medium containing UCM and, subsequently, Ordinary Matter generated through UCP processes [1,5].

Before this stage, the fundamental length a and fundamental time $t_0 = a/c$ can be used mathematically within the extrapolated relationships of the Model, but the physical Cosmic Medium has not yet emerged.

The emergence of UCF1 marks the physical beginning of the Cosmic Medium; its subsequent evolution is determined by the continuing generation and development of the multicomponent UCP system.

The Cosmic Medium is therefore not identified with geometrical extension, with the 4D Nucleus itself, or with an abstract vacuum. It 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.**

8.2. Cosmic Medium and Classical Physics

WUM is constructed as a classical physical model. Classical physical concepts become applicable when a physical Medium composed of Matter exists.

The emergence of the Cosmic Medium at approximately

$$\tau_{CM} \sim 1.109 \times 10^{-18} \text{ s}$$

marks a fundamental transition in the physical description of the World.

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 [1,5].

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

The laws of Classical Physics are therefore not regarded in WUM as laws operating in an independently existing physical Nothing. They describe Matter and the physical Medium constituted by Matter.

8.3. Time, Space, and the Cosmic Medium

Within WUM, Time and Space are closely connected with physical characteristics of the Cosmic Medium. The Impedance of the Medium is characterized by the Hubble parameter

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

The spatial properties of the Medium are connected with its Gravitomagnetic parameter.

These relationships mean that physical Time and physical Space cannot be separated from the Medium possessing the corresponding properties.

This statement must be distinguished from the geometrical description used in WUM. The Model employs the geometry of the expanding 4D Nucleus and its 3D hyperspherical surface. Geometry describes the structure of the World, but geometry itself is not Matter and should not be confused with the physical Cosmic Medium.

WUM therefore distinguishes **geometrical dimensionality** from the physical properties conventionally associated with Space and Time.

The former belongs to the geometrical construction of the Model. The latter acquire their physical meaning through the Matter-filled Cosmic Medium.

8.4. Cosmic Medium and Gravitation

The role of the Cosmic Medium becomes especially important in the WUM interpretation of Gravitation.

Within WUM, Gravitation is not introduced as a fundamental interaction operating across empty space. It is interpreted as a physical manifestation of the Cosmic Medium.

Within the Model, the gravitational parameter G is related to the energy density and physical state of the Matter-filled Medium. The gravitational parameter is proportional to the energy density of the Cosmic Medium ρ_{CM} , which is inversely proportional to cosmological time:

$$G \propto \rho_{CM} \propto \tau^{-1}$$

Gravitation consequently cannot be separated from the physical state and cosmological evolution of the Cosmic Medium.

WUM develops this interpretation through a Le Sage-type mechanism of Gravitation. The microscopic constituents proposed to participate in this mechanism are **XIONs**, the lowest-rest-energy members of the Universe-Created Particle system, with theoretically calculated rest energy [1,5]

$$E_{XION} = 1/2 K_U^6 E_0 = 5.2870895 \mu eV$$

XIONs therefore occupy a special position in WUM. In addition to their predicted microscopic and radio-frequency manifestations, their collective behavior is proposed to provide the physical basis for Gravitation.

The proposed microscopic mechanism is considered in the following subsection.

8.5. Le Sage Mechanism of Gravitation in WUM

The microscopic basis proposed for the WUM mechanism of Gravitation is the population of **XIONs**, the lowest-rest-energy members of the UCP system. XIONs constitute a pervasive component of the Cosmic Medium and interact with Matter through Weak Interactions.

An isolated physical object immersed in a homogeneous and isotropic XION background experiences balanced action from all directions and therefore no net gravitational effect arising from a directional imbalance in this background.

When two physical objects are present, each object modifies the XION flux reaching the other. The presence of one object produces a small anisotropy in the otherwise isotropic XION background experienced by the second object. The resulting imbalance of XION action produces an effective attraction between them.

The same physical argument applies reciprocally to both objects. Gravitation therefore appears macroscopically as mutual attraction, while microscopically it is proposed in WUM to originate from the interaction of Matter with the XION component of the Cosmic Medium.

In this interpretation, gravitational attraction does not require Matter to act directly upon distant Matter across empty space. The Cosmic Medium provides the physical intermediary.

The magnitude of the macroscopic gravitational effect depends on the properties of the XION background and its interaction with Matter. Within WUM, this connects the gravitational parameter (G) with the energy density and physical properties of the Cosmic Medium.

The WUM interpretation retains the central physical idea historically associated with the Le Sage mechanism—an isotropic particle background whose local imbalance produces apparent attraction—but identifies a specific proposed microscopic constituent of that background: **XIONs**.

This provides an important connection between the microscopic and macroscopic parts of WUM. XION is not merely the lowest-rest-energy member of the seven-UCP spectrum; its collective interaction with Matter is proposed to produce the phenomenon observed macroscopically as Gravitation.

The XION hypothesis is therefore subject to two complementary observational requirements. Its microscopic properties must be consistent with the predicted low-rest-energy and radio-frequency phenomena, while its collective behavior must reproduce the observed macroscopic properties of Gravitation.

8.6. Energy Density and Distribution of Universe-Created Matter

Within WUM, Universe-Created Matter constitutes approximately **92.8% of the total energy density of the World**. UCM is distributed between the Cosmic Medium and the structured components associated with Macroobjects [1,5].

Thus, the Cosmic Medium should not be identified with the entirety of Universe-Created Matter. UCM denotes the complete Matter component continuously generated by the Eternal Universe, whereas CM denotes the broadly distributed physical Medium containing both UCM and Ordinary Matter generated from it.

Concentrations of UCM in Cores and surrounding shells participate in the formation, internal structure, and evolution of Macroobjects.

The Cosmic Medium is homogeneous and isotropic. By contrast, UCM concentrated in Cores and shells represents the structured UCM component associated with Macroobjects.

This distinction is also important for the observational tests developed in the present paper. Some manifestations of UCPs should be sought in the broadly distributed Cosmic Medium, whereas others are expected preferentially in UCM-rich Cores, shells, and UARs.

The Cosmic Medium and Universe-Created Matter should therefore not be identified with one another. **UCM denotes Matter of Universe-created origin, whereas CM denotes the physical Matter-filled Medium. A substantial fraction of UCM resides in the Cosmic Medium, while another fraction is concentrated in the Cores and shells of Macroobjects.**

8.7. Content of the Observable World

The **Observable World (OW)** consists of the Cosmic Medium CM and Macroobjects. Within WUM, the total energy density of the Observable World equals the critical energy density throughout the evolution of the World.

The energy density of the Cosmic Medium constitutes two-thirds of the total energy density, while Macroobjects—including Superclusters, Galaxies, Extrasolar Systems, and other gravitationally bound structures—constitute one-third at all cosmological times.

Universe-Created Matter accounts for approximately 92.8% of the total energy density of the World. Ordinary Matter and radiation account for the remaining approximately 7.2%, distributed between the Cosmic Medium and Macroobjects.

An important distinction must therefore be maintained between the **total energy density of the Cosmic Medium** and the **total UCM energy density**. The two-thirds/one-third division refers to the complete energy content of the Cosmic Medium and Macroobjects, respectively, whereas the approximately 92.8% value refers specifically to Universe-Created Matter.

Ordinary Particles—protons, electrons, photons, and neutrinos—account for the remaining component, distributed between the Cosmic Medium and Macroobjects.

One of the principal propositions of WUM is that the relative energy densities of the World's particles, expressed in terms of the critical energy density ρ_{cr} , remain constant throughout cosmological evolution. These relative energy densities are proportional to the proton energy density in the Cosmic Medium ρ_p , which at the present epoch is given by [17]:

$$\rho_p = \frac{2\pi^2\alpha}{3} \rho_{cr} = 0.048014655 \rho_{cr}$$

Earlier formulations of WUM employed the quantity conventionally known as the fine-structure constant (α) in these relationships. In the present formulation, an important distinction is introduced. The conventional fine-structure constant is retained in relationships specifically involving Ordinary Matter, whereas the **Universe Constant K_U** characterizes fundamental dimensionless relationships attributed in WUM to the physical structure of the World as a whole.

The relationship between these quantities is considered in Section 8.8.

WUM proposes that the energy densities of all self-annihilating UCP species are proportional to the same fundamental quantity. Six distinct types of self-annihilating UCPs are considered:

UCF1, UCF2, DIRAC, ELOP, UCF3, and UCF4.

The total energy density of these UCPs ρ_{UCP} is therefore

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

which is consistent with the result discussed in [18].

The total XION energy density ρ_{XION} is

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

The total baryonic energy density ρ_B is

$$\rho_B = 1.5 \rho_p$$

The combined electron and Microwave Background Radiation energy density ρ_{eMBR} is

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

The neutrino energy density ρ_ν is taken to be

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

and for the Far-Infrared Background Radiation energy density ρ_{FIRB} we use

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

The sum of these contributions gives the total energy density of the Observable World:

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

which is equal to the theoretical critical energy density.

This relationship provides an important internal consistency condition for WUM. The individual particle components are not assigned arbitrary fractions independently of one another; their relative energy densities are connected through the fundamental dimensionless relationships of the Model.

From the complete energy-density equation, together with the electron-to-proton rest-energy ratio, one obtains

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

in excellent agreement with the experimentally established value associated with Ordinary Matter.

The result demonstrates a direct relationship between the dimensionless constants entering the WUM description. In the framework developed here, these quantities are not treated as an unrelated collection of empirical numbers but as interconnected characteristics of the same physical system.

The principal conclusions of this subsection can therefore be stated as follows.

The total energy density of the World evolves inversely with the time-dependent World Parameter Q , while the **relative energy densities of its particle components remain constant throughout cosmological evolution**.

The absolute energy densities evolve with the World, but their dimensionless ratios to the critical energy density remain fixed.

This provides the quantitative connection between the multicomponent UCP system, Ordinary Matter, the Cosmic Medium, Macroobjects, and the total energy content of the Observable World.

8.8. Universe Constant and Fundamental Dimensionless Relationships

The preceding discussion introduces the **Universe Constant** K_U as a fundamental dimensionless quantity of WUM. It is important to distinguish this quantity explicitly from the conventional fine-structure constant and from the evolving World Parameter Q :

The currently recommended value of the conventional fine-structure constant is

$$\alpha_{exp}^{-1} \approx 137.035999177$$

Several authors have noted that this dimensionless quantity can be approximated with remarkable accuracy by compact expressions involving π .

In 2019, J. Yee proposed an expression involving only π [19]:

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

which reproduces the measured value to approximately six decimal places.

A second well-known numerical relationship concerns the proton-to-electron mass ratio. In 1951, F. Lenz noted that this ratio can be represented with remarkable accuracy by the compact expression [20]:

$$(m_p/m_e)_T = 6\pi^5 \approx 1836.118109$$

The currently recommended proton-to-electron mass ratio is

$$(m_p/m_e)_{exp} \approx 1836.152673426$$

while

$$\frac{(m_p/m_e)_{exp}}{(m_p/m_e)_T} \approx 1.000018825$$

reproduces it to approximately five decimal places.

Such numerical relationships do not by themselves establish a physical theory. Nevertheless, their simplicity raises a legitimate question: whether dimensionless physical constants that appear empirically independent may instead reflect a deeper common structure.

Amir, Lemeshko, and Tokieda examined the general problem of unexpectedly accurate numerical expressions for physical constants and discussed quantitatively the probability of obtaining such coincidences from combinations of familiar mathematical constants [21].

WUM interprets dimensionless relationships of this type within its hyperspherical description of the World.

In the present formulation, the **Universe Constant** K_U is a fixed dimensionless quantity associated with the Eternal Universe and ultimately expressed through the fundamental geometrical quantity π :

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

The Universe Constant must be clearly distinguished from the **World Parameter** Q :

$$Q = Q(\tau)$$

The distinction is fundamental.

K_U is constant, whereas Q evolves with absolute cosmological time and provides a dimensionless measure of both the Size and Age of the World.

Together, these two quantities provide the principal dimensionless foundation of WUM.

Their importance for the present paper is particularly clear in the UCP system. The heavy and light members of the two principal UCP couples are related through the fixed Universe Constant:

$$E_{light} = K_U^2 \times E_{heavy}$$

and

$$E_{heavy} = K_U^{-2} \times E_{light}$$

Thus, the predicted DIRAC and ELOP rest energies are not independent adjustable quantities. They follow from the corresponding heavy-particle rest energies through the same fixed dimensionless constant.

This provides the principal reason for introducing the Universe Constant explicitly in the present work. K_U is not introduced to reproduce a particular astronomical spectrum. It belongs to the fundamental structure of WUM and appears independently in relationships connecting the particle content, energy densities, and fundamental dimensionless quantities of the World.

WUM is therefore constructed around two fundamentally different dimensionless parameters:

- the Universe Constant K_U , which is fixed, and
- the World Parameter Q , which evolves with absolute cosmological time.

Other dimensionless physical quantities are proposed to arise from these fundamental parameters together with π , small integers, rational coefficients, and rational exponents [22].

This distinction also separates two aspects of the Model. K_U characterizes permanent relationships within the physical structure of the World, whereas Q describes its continuing cosmological evolution.

The UCP spectrum considered in this paper consequently does not consist of seven independently selected particle rest energies. It belongs to a physical framework in which microscopic particle scales, cosmological energy densities, and the evolution of the World are connected through a small number of fundamental quantities.

8.9. Matter Instead of Nothing

The physical and philosophical distinction among the **Eternal Universe, the World, and the Cosmic Medium** is fundamental in WUM.

The Eternal Universe is eternal. The World has a finite age and is described geometrically as the three-dimensional hyperspherical surface of the expanding 4D Nucleus [5]. **The Cosmic Medium is the physical Matter-filled Medium of the World and emerges with the appearance of UCF1.**

Consequently, the absence of the Cosmic Medium must not be confused with the absence of the Eternal Universe.

Before the emergence of UCF1, the Eternal Universe and the geometrical construction underlying the World remain fundamental to WUM, but the classical physical properties associated with the Cosmic Medium have not yet emerged.

This leads to an important philosophical position of the Model: **Matter is primary with respect to the physical properties of the World.**

WUM does not begin with an empty physical spacetime endowed with its own material properties and subsequently insert Matter into it. The appearance of Universe-Created Matter establishes the Cosmic Medium, and the classical physical properties of the World emerge with that Medium.

If Matter is removed, the Cosmic Medium is removed with it. There is no physical Impedance of Nothing, no Gravitomagnetic property of Nothing, and no energy density of Nothing. Within WUM, physical Space, physical Time, and Gravitation therefore cannot possess an existence independent of the Matter-filled Cosmic Medium.

The Cosmic Medium consequently provides the physical foundation within which UCPs form ensembles, Macroobjects develop, UARs operate, Ordinary Matter is generated, and Gravitation emerges.

The fundamental position can therefore be stated simply:

An empty physical World is not the physical arena of WUM; the Cosmic Medium itself is constituted by Matter.

The beginning of the Cosmic Medium is likewise physically defined.

The Cosmic Medium begins with Matter. In WUM, its beginning is marked by the emergence of UCF1 at

$$R_{CM} \sim 3.325 \times 10^{-10} \text{ m}$$

$$\tau_{CM} \sim 1.109 \times 10^{-18} \text{ s}$$

9. UCP Annihilation Reactors

A fundamental consequence of the UCM Core concept is the existence of **UCP Annihilation Reactors (UARs)**. A UAR is a physical system in which the continuing supply, interaction, and annihilation of UCPs release energy and produce radiation, energetic particles, and Ordinary Particles.

In WUM, the Cores of gravitationally rounded Macroobjects function as UARs that are continuously supplied with Universe-Created Particles. Within these Cores, UCPs interact and are proposed to undergo self-annihilation and related transformation processes. These processes provide continuing internal sources of energy, electromagnetic radiation, energetic particles, and Ordinary Particles [1,5].

A **UAR** is therefore not analogous to a conventional nuclear reactor operating through nuclear fission or fusion alone. It is a physical system whose activity is maintained by the continuing supply, interaction, and annihilation of Universe-Created Particles within the Core of a Macroobject.

UARs are proposed to operate throughout a broad hierarchy of astronomical objects, including galaxies, stars, planets, moons, and other gravitationally rounded Macroobjects. Although these systems differ enormously in size and environment, WUM proposes that their Cores share the same fundamental physical principle: they contain Universe-Created Matter and can remain internally active through processes involving UCPs.

This concept provides WUM with a common physical mechanism for phenomena occurring on very different astronomical scales. Proposed manifestations of **UAR activity** include internal heating of gravitationally rounded bodies, energetic activity in stellar and planetary systems[1,5,10].

The observational significance of a candidate UCP signature therefore depends not only on its energy. A spectral feature near a predicted UCP rest energy becomes more significant if it is observed in an astrophysical environment that independently exhibits properties expected of an active **UAR**.

The evidence would become stronger if several consequences predicted by WUM were observed together—for example, characteristic UCP radiation, substantial internal energy production, energetic particles, and other manifestations associated with the same UCM structure. For theoretically related UCP couples, detection of signatures corresponding to both members in the same or physically connected environments would provide an even more restrictive test.

UARs thus provide the physical setting in which the microscopic UCP spectrum can produce observable macroscopic phenomena. They also provide a natural connection to the next question: how the interactions and annihilation of Universe-Created Particles can participate in the generation of **Ordinary Matter**.

10. Generation of Ordinary Matter by UCPs

The generation of Ordinary Matter constitutes another fundamental role of Universe-Created Particles, although it represents only one aspect of the broader physical activity of Universe-Created Matter.

Within WUM, Ordinary Matter is not regarded as a complete primordial inventory introduced at the Beginning of the World. Universe-Created Matter is continuously generated by the Eternal Universe within the expanding 4D Nucleus in the form of UCPs. Interactions, annihilation, and transformation processes involving particular UCP species subsequently provide proposed mechanisms for the generation of Ordinary Particles [1,4].

Several members of the UCP system have specific roles in this process.

10.1. UCF1

UCF1 is a heavy Universe-Created Fermion with a characteristic rest energy of approximately

$$E_{\text{UCF1}} \sim 1.3 \text{ TeV}$$

Within WUM, annihilation processes involving UCF1 are proposed to participate in the generation of **protons and electrons** [1,4].

This provides a physical route from Universe-Created Matter to two of the principal constituents of Ordinary Matter. Protons and electrons subsequently provide the foundation for the formation of hydrogen atoms and, through further physical processes, more complex forms of Ordinary Matter.

UCF1 therefore has a dual importance in the Model. Its predicted rest energy provides a high-energy observational target, while its proposed annihilation products connect the UCP system directly with the continuing generation of Ordinary Matter.

10.2. DIRAC

DIRAC is a light spin-0 boson with the characteristic rest energy

$$E_{\text{DIRAC}} \sim 70.025 \text{ MeV}$$

As discussed in Section 5, DIRACs are conceived in WUM as dipoles composed of **Dirac magnetic monopoles**.

Dirac established a fundamental connection between the possible existence of magnetic monopoles and the quantization of electric charge [14]. WUM develops this idea in a different physical direction by proposing that processes involving DIRACs participate in the generation of **Dirac magnetic monopoles together with electrons and positrons** [1,4].

DIRAC consequently has more than one potentially testable physical manifestation. Its pair annihilation is proposed in WUM to produce characteristic gamma-ray radiation associated with the approximately 70-MeV scale, while **other processes involving DIRACs** are proposed to participate in the production of monopoles, electrons, and positrons [1,4].

The observational investigation of DIRAC should therefore not be restricted to gamma-ray spectra alone. Evidence connecting the predicted rest-energy scale with the associated particle products would provide a considerably stronger test of its proposed physical role.

10.3. ELOP

ELOP is a light spin-0 boson with a characteristic rest energy of approximately

$$E_{\text{ELOP}} \sim 340 \text{ keV}$$

Within WUM, an ELOP is conceived as a dipole composed of **preons** carrying electric charge $e/3$ [1,4].

These preons are proposed to serve as constituents of atomic nuclei.

ELOP therefore provides another connection between the predicted UCP spectrum and the microscopic structure of Ordinary Matter. Its approximately 340-keV rest energy provides an observational target, while its proposed preonic constituents provide a specific physical role in the generation and structure of atomic nuclei.

10.4. UCPs and the Continuing Generation of Ordinary Matter

UCF1, DIRAC, and ELOP illustrate how the UCP system is proposed to connect Universe-Created Matter with Ordinary Matter.

Within WUM, UCF1 annihilation participates in the generation of protons and electrons. Processes involving ELOPs are proposed to provide preons with electric charge $e/3$, which serve within WUM as constituents involved in the formation of atomic nuclei.

These processes are not independent additions to the Model. They are different manifestations of the same underlying proposition: Universe-Created Matter is continuously generated in the form of UCPs, and particular UCP species subsequently participate in the production and structure of Ordinary Matter.

The origin of Ordinary Matter is therefore incorporated into the continuing physical evolution of the World rather than confined exclusively to its Beginning.

This proposed connection between predicted UCP rest energies and specific particle products also creates an important observational and experimental requirement. Evidence for a UCP becomes substantially stronger when a characteristic rest-energy signature can be associated with additional physical products independently predicted for that particle.

The complete test must therefore examine not only whether the predicted UCP energy scales appear in Nature, but also whether the associated particle-production processes and astrophysical environments are consistent with the physical roles assigned to the corresponding UCPs.

The following section examines the quantitative observational evidence for the individual members of the UCP system.

11. Quantitative Observational Evidence for Universe-Created Particles

A principal experimental advantage of the Universe-Created Particle hypothesis is its quantitative character. UCPs are not introduced merely as an unspecified invisible component required to reproduce gravitational phenomena. WUM predicts a discrete multicomponent system of seven UCPs with definite rest energies extending over more than seventeen orders of magnitude.

Several of these rest energies were introduced in WUM before the astronomical and experimental results discussed below. Consequently, the relevant question is not whether an observed spectrum can be fitted retrospectively by introducing a new particle energy, but whether independently obtained observations contain characteristic structures at theoretically predetermined UCP energy scales.

A uniform evidentiary standard is therefore adopted throughout this section:

- A continuous astronomical spectrum that merely passes through a predicted UCP rest-energy scale demonstrates observational accessibility or consistency, but it is not regarded as quantitative confirmation.
- A measured spectral line, peak, break, hardening, discrete band, or other characteristic structure at or near a predetermined UCP scale constitutes substantially stronger evidence.
- Still stronger evidence is obtained when comparable characteristic structures are reported independently by different instruments, in different astronomical objects, or through several related phenomena.

The observational status of each UCP is therefore described according to the strength and character of the available quantitative correspondence. Particular care is taken to distinguish a correspondence with a predicted energy scale from direct identification of the proposed particle.

11.1. UCF1: The 1.3-TeV Energy Scale

UCF1 is the highest-rest-energy component of the seven-UCP system. Its rest energy is determined in WUM by

$$E_{UCF1} = K_U^{-2} E_0$$

giving approximately

$$E_{UCF1} \sim 1.3 \text{ TeV}$$

The approximately 1.3-TeV component appeared in the early WUM multicomponent particle spectrum and was explicitly presented in the 2014 paper *World-Universe Model. Multicomponent Dark Matter. Cosmic Gamma-Ray Background* [3]. In the earlier terminology it was described using a conventional dark-matter-particle designation; in the present formulation it is called UCF1.

The DAMPE Collaboration measured the cosmic-ray helium spectrum from approximately 70 GeV to 80 TeV and reported a spectral hardening at approximately [23]:

$$E_{\text{hardening}} \sim 1.3 \text{ TeV}$$

Thus,

$$E_{UCF1}^{WUM} \sim 1.3 \text{ TeV}$$

while independently,

$$E_{\text{hardening}}^{DAMPE} \sim 1.3 \text{ TeV}$$

The TeV domain is experimentally accessible through several complementary techniques.

Method	Detection mechanism	Representative experiments
Space-based particle detectors	Direct measurement of high-energy charged particles above most of Earth's atmosphere	DAMPE, CALET
Space-based gamma-ray telescopes	Detection of high-energy gamma rays before atmospheric absorption	Fermi-LAT
Imaging Atmospheric Cherenkov Telescopes	Detection of Cherenkov radiation from atmospheric particle showers initiated by VHE gamma rays	H.E.S.S., MAGIC, VERITAS
Ground-based air-shower arrays	Detection of secondary particles generated in extensive atmospheric showers	HAWC, LHAASO

These observations establish the physical reality of astrophysical processes in the TeV domain. Spectral coverage through 1.3 TeV, however, is not by itself evidence for UCF1. Of considerably greater importance is an experimentally measured **spectral structure near the predicted energy**.

This correspondence is qualitatively different from an astronomical spectrum that merely extends through the TeV domain: the measured spectrum itself changes behavior near the predicted UCF1 scale.

CALET independently measured the cosmic-ray helium spectrum over a broad energy range from 40 GeV to 250 TeV and found significant progressive spectral hardening in the TeV domain. The CALET result supports the general existence of non-power-law structure in the same energy region, although it should not be interpreted as an independent sharp break precisely at 1.3 TeV.

Other experiments, including PAMELA, AMS-02, ATIC, CREAM, and NUCLEON, have established departures from simple single-power-law behavior in cosmic-ray nuclei. Together, these measurements demonstrate that the TeV-scale structure observed by DAMPE belongs to a broader experimentally established phenomenon of cosmic-ray spectral hardening.

Within conventional cosmic-ray physics, such structures are discussed in terms of source populations, particle acceleration, propagation, and related processes. WUM proposes a different physical interpretation in which the approximately 1.3-TeV scale is associated with UCF1.

UCF1 is additionally the heavy member of the UCF1–DIRAC couple:

$$E_{DIRAC} = K_U^2 E_{UCF1}$$

with

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

The UCF1 energy is therefore not an adjustable quantity introduced to reproduce the helium spectrum. It belongs to an interconnected theoretical particle system.

Present status: Quantitative correspondence with a measured spectral feature.

The independently predicted approximately 1.3-TeV UCF1 energy scale corresponds directly to a characteristic spectral hardening measured by DAMPE. This constitutes quantitative support for the predicted energy scale, while direct identification of UCF1 as a particle remains a separate experimental question.

11.2. UCF2: The 9.6-GeV Energy Scale

WUM predicts the second heavy Universe-Created Fermion, UCF2, with rest energy:

$$E_{UCF2} \sim 9.6 \text{ GeV}$$

This value belongs to the predetermined multicomponent UCP spectrum and is not obtained by fitting the gamma-ray observations discussed below.

The approximately 10-GeV region is particularly interesting because characteristic gamma-ray structures have been reported in several independent astrophysical environments.

Fermi-LAT observations of the Galactic Center have established an extended GeV excess relative to conventional diffuse-emission models [24,25]. Its detailed spectrum depends strongly on the adopted Galactic foreground, source population, morphology, and analysis procedure, and its principal spectral maximum is generally broad rather than a narrow feature precisely at 9.6 GeV.

Hooper [26] analyzed the gamma-ray emission observed by Fermi-LAT from the Galactic Center and discussed its interpretation in terms of annihilating dark matter. The analysis identified a GeV gamma-ray excess whose spectrum can be reproduced, under the annihilating-particle interpretation considered there, by particles with rest energies in the approximately 10-GeV range.

It is worth noting that a similar gamma-ray excess has been observed in the central region of the Andromeda galaxy (M31). McDaniel, Jeltama, and Profumo [27] calculated the expected multiwavelength emission from annihilating dark matter and compared it with available observations of M31. Among the models considered, they obtained a best-fitting particle rest energy of approximately 11 GeV, close to the independently predicted UCF2 rest energy of approximately 9.6 GeV.

These results do not represent direct measurements of a particle at 9.6 GeV. Rather, they provide two independent astrophysical cases in which interpretations of observed gamma-ray emission in terms of particle annihilation lead to characteristic particle rest energies in approximately the same 10-GeV domain as the predetermined WUM value for UCF2.

At the same time, the present measurements do not establish a universal narrow feature centered specifically at 9.6 GeV. Their interpretation depends on the adopted astrophysical backgrounds, source models, and particle-annihilation models.

Within WUM, the approximately 9.6-GeV scale is associated with UCF2.

UCF2 is additionally the heavy member of the UCF2–ELOP couple:

$$E_{ELOP} = 2/3 K_U^2 E_{UCF2}$$

with

$$E_{ELOP} \sim 340 \text{ keV}$$

The strongest test of UCF2 is therefore not the approximately 10-GeV correspondence alone, but the possible appearance of both members of the theoretically predetermined UCF2–ELOP couple in astrophysical environments associated with UCM activity.

Present status: Broad quantitative correspondence requiring improved energy localization.

11.3. DIRAC: The 70.025-MeV Energy Scale

DIRAC is predicted in WUM to be a light spin-0 boson with rest energy:

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

It is proposed to be a dipole of Dirac magnetic monopoles and constitutes the light member of the UCF1–DIRAC couple:

$$E_{DIRAC} = K_U^2 E_{UCF1}$$

Under a symmetric two-photon annihilation process with negligible center-of-momentum motion, a characteristic photon energy near the DIRAC rest-energy scale would be expected.

The observational problem is that this scale lies close to the characteristic photon energy associated with neutral-pion decay.

For a neutral pion at rest,

$$\pi^0 \rightarrow \gamma + \gamma$$

and

$$E_{\gamma} \sim 67.49 \text{ MeV}$$

The difference between the two characteristic energies is only approximately 2.54 MeV, or 3.8%.

Neutral-pion decay is experimentally established [8,9]. In astrophysical environments, however, pions possess distributions of energies and momenta, producing a broad gamma-ray spectrum rather than a narrow 67.49-MeV line. Fermi-LAT observations of IC 443 and W44 provide strong evidence for this characteristic pion-decay spectral structure [9].

Consequently, the observational problem cannot realistically be reduced to resolving two ideal narrow lines at 67.49 and 70.025 MeV.

Nor should every gamma-ray contribution near 70 MeV automatically be assigned to DIRAC. Conversely, the existence of the broad pion-decay spectrum does not by itself demonstrate that every contribution in this region must originate from neutral pions.

The discriminating test must therefore use information beyond photon energy alone.

Within WUM, DIRAC belongs to the UCF1–DIRAC couple. Evidence for the approximately 70-MeV scale becomes more significant if it occurs in an environment that also exhibits manifestations associated with UCF1 near 1.3 TeV and with the proposed products of the UCF1–DIRAC system.

The approximately 70-MeV correspondence should therefore be evaluated as part of a **coupled-particle test**, rather than as an isolated gamma-ray line search.

Present status: Specific prediction requiring discrimination from neutral-pion emission.

The relevant gamma-ray domain is experimentally established, but the proximity of the broad neutral-pion-decay spectrum presently prevents an unambiguous DIRAC identification from photon energy alone.

11.4. ELOP: The 340-keV Energy Scale

ELOP is the light spin-0 member of the UCF2–ELOP couple. WUM predicts:

$$E_{ELOP} \sim 340 \text{ keV}$$

with

$$E_{E\text{LOP}} = 2/3 K_U^2 E_{UCF2}$$

Within WUM, ELOP is proposed to be a dipole composed of preons carrying electric charge $e/3$, and ELOP processes are proposed to participate in the generation of preons involved in the structure of Ordinary Matter.

The approximately 340-keV domain is experimentally accessible in hard-X-ray and soft-gamma-ray astronomy.

Grigis and Benz, in the paper “*Spectral Hardening of Large Solar Flares*,” presented results of spectroscopy, imaging, and modeling of spectral hardening observed in the hard-X-ray emission of large solar flares [28].

The solar environment is especially interesting within WUM because the Cores of astronomical Macroobjects are proposed to function as **UCP Annihilation Reactors (UARs)**. Solar high-energy phenomena are therefore among the environments in which manifestations of UCP annihilation and transformation should be sought.

ELOP is not an isolated predicted particle. It belongs to the UCF2–ELOP couple,

$$E_{UCF2} \sim 9.6 \text{ GeV}$$

$$E_{E\text{LOP}} \sim 340 \text{ keV}$$

with the two scales connected through the same Universe Constant K_U^2 .

Thus, two widely separated characteristic energy domains—approximately 9.6 GeV and 340 keV—are theoretically linked within a single UCP couple.

The approximately 340-keV ELOP prediction therefore defines a specific observational target in solar and other high-energy astrophysical environments.

If a single ELOP undergoes a symmetric two-photon decay, with its rest energy shared equally between the two photons, the characteristic photon energy would be approximately 170 keV.

An additional observational energy scale of interest is therefore the approximately 170-keV gamma-ray feature reported from the direction of the Galactic Center [16].

Present status: Specific predictions at approximately 340 keV and 170 keV in experimentally accessible energy domains, requiring quantitatively localized spectral tests.

Existing observations establish hard-X-ray and soft-gamma-ray activity in astrophysical environments relevant to WUM, including spectral hardening in large solar flares and a reported gamma-ray feature near 170 keV toward the Galactic Center. A decisive ELOP test, however, requires reproducible characteristic spectral structure quantitatively localized near the predicted approximately 340-keV scale and/or the derived approximately 170-keV photon-energy scale.

11.5. UCF3: The 3.7-keV Energy Scale

UCF3 provides one of the most interesting X-ray tests of the UCP spectrum.

WUM predicts:

$$E_{UCF3} \sim 3.7 \text{ keV}$$

Unlike a continuous X-ray spectrum merely passing through this energy, several independent observations have reported characteristic spectral structures in the vicinity of 3.7 keV.

Early X-ray observations of sources in Cygnus and Scorpio by Gorenstein, Giacconi, and Gursky reported substantial counts in the several-keV domain, including structure around the energy subsequently associated in WUM with UCF3 [29]. In their energy-binned measurements, a particularly large number of net counts was recorded in the bin centered near 3.75 keV.

ROSAT and ASCA observations of W50 associated with SS 433 reported spectral behavior characterized by a break near approximately 3.7 keV [30].

Bykov and collaborators, studying isolated X-ray–infrared sources in the IC 443 supernova remnant, reported evidence in some clumps for line emission near approximately 1.9 and 3.7 keV, with the 3.7-keV feature in one source reported at approximately 99% confidence [31].

Observations of the active galaxy NGC 4388 have also shown line-like residuals in the vicinity of approximately 3.7 keV [32].

Suzaku observations adjacent to the southern end of the Galactic Radio Arc reported another line-like residual in approximately the same energy region [33].

These observations are heterogeneous. They involve different source classes, instruments, spectral models, and types of structure: maxima, breaks, and line-like residuals should not be treated as physically identical phenomena (see **Table 2**).

Table 2. Representative X-Ray Results Near the Predicted UCF3 Energy.

Source / Observation	Reported structure	Energy domain	Reference
Cygnus/Scorpio X-ray sources	Spectral/count structure in several-keV region	near UCF3 domain	[29]
W50 / SS 433	Spectral break	$\sim 3.7 \text{ keV}$	[30]
IC 443	Line-like emission in selected clumps	$\sim 3.7 \text{ keV}$	[31]
NGC 4388	Line-like residual	$\sim 3.7 \text{ keV}$	[32]
Galactic Radio Arc region	Line-like residual	$\sim 3.7 \text{ keV}$	[33]

Conventional atomic and plasma explanations also exist for some features in this energy region. In particular, atomic transitions can occur near 3.7 keV and must be included in detailed source-specific modeling.

Nevertheless, the repeated appearance of characteristic spectral structure in the vicinity of the independently predicted UCF3 scale is quantitatively more significant than a single continuous spectrum crossing 3.7 keV.

The significance of the UCF3 case lies in the occurrence of approximately the same characteristic energy in physically different astronomical environments.

Present status: Multiple independently reported spectral correspondences near the predicted UCF3 energy scale, requiring source-specific interpretation.

The predicted approximately 3.7-keV scale is associated with multiple independently reported X-ray spectral structures. These correspondences support continued investigation of the predicted UCF3 energy scale, while direct particle identification remains a separate experimental question.

11.6. UCF4 and the Unidentified Infrared Bands

One of the most highly structured quantitative comparisons for the UCP hypothesis is associated with UCF4. In earlier WUM terminology, this particle was called DION. Its predicted rest energy is approximately:

$$E_{\text{UCF4}} \sim 0.2 \text{ eV}$$

domain.

Astronomical observations reveal the well-known Unidentified Infrared Bands (UIBs), with principal features near:

$$3.3, 6.2, 7.7, 8.6, 11.2, 12.7 \mu\text{m}$$

The corresponding observed photon energies are approximately:

$$0.376, 0.200, 0.161, 0.144, 0.111, 0.098 \text{ eV}$$

In 2022, WUM proposed that these discrete infrared emissions result from self-annihilation processes involving UCF4 particles and bound UCF4 pairs. The calculation is based on the predicted UCF4 rest-energy scale and conservation of energy in two- and three-photon annihilation channels.

Representative combinations of the rounded observed photon energies include

$$0.161 + 0.144 + 0.111 = 0.416 \text{ eV}$$

$$0.161 + 0.144 + 0.098 = 0.403 \text{ eV}$$

$$0.200 + 0.111 + 0.098 = 0.409 \text{ eV}$$

These combinations should ultimately be evaluated using the precise quantities employed in the original WUM calculation rather than only the rounded wavelengths reproduced in **Table 3**.

Table 3. UCF4 Self-Annihilation Channels and Observed Unidentified Infrared Bands

UCF4 self-annihilation channel	Calculated photon energy (eV)	Calculated wavelength (μm)	Observed UIB
Bound UCF4 pair: two-photon channel	0.376	3.3	3.3
UCF4: two-photon channel	0.200	6.2	6.2
UCF4: three-photon channel	0.161	7.7	7.7
UCF4: three-photon channel	0.144	8.6	8.6
UCF4: three-photon channel	0.111	11.2	11.2
UCF4: three-photon channel	0.098	12.7	12.7

The importance of the UCF4 result is that WUM does not merely associate one particle with the general infrared domain. Starting from one theoretically specified UCF4 rest-energy scale, the proposed self-annihilation processes **account quantitatively within WUM** for a family of six independently observed astronomical infrared bands.

The conventional interpretation is fundamentally different. The astronomical bands themselves are observations. Their attribution to polycyclic aromatic hydrocarbons (PAH) and related carbonaceous material is based on molecular vibrational spectroscopy [34].

Laboratory spectroscopy and molecular calculations demonstrate PAH vibrational features in the relevant infrared regions. Conventional explanations generally invoke populations of molecules with different

structures, sizes, ionization states, charge states, and vibrational modes rather than the spectrum of one uniquely identified PAH molecule under one set of physical conditions. Questions concerning the formation, evolution, and astronomical distribution of these complex carbonaceous populations remain part of the broader astrophysical problem.

WUM instead proposes that the complete characteristic band family belongs to **one physical system governed by UCF4 self-annihilation**.

The appropriate quantitative comparison is therefore between the UCF4 calculation and the independently measured astronomical wavelengths.

This result is qualitatively stronger than a single energy correspondence. Six observed infrared energies are related within one theoretical particle framework based on a predetermined UCF4 rest-energy scale.

Present status: Multiband quantitative correspondence requiring verification of the complete annihilation calculation.

The UCF4 result constitutes one of the most restrictive quantitative tests of the seven-UCP spectrum because it connects a single UCP species with an entire system of characteristic astronomical energies.

11.7. XION: The Radio-Frequency Energy Scale and Gravitation

XION occupies the lowest-rest-energy end of the seven-UCP spectrum. Its theoretically predicted rest energy is

$$E_{XION} = 5.2870895 \mu eV$$

This places XION in the radio-frequency domain.

A particularly interesting comparison arises with the neutral-hydrogen 21-cm domain. The photon energy corresponding to the intrinsic 21-cm hyperfine transition is

$$E_{21} \sim 5.87 \mu eV$$

The predicted XION rest energy and the photon energy of the neutral-hydrogen 21-cm transition are therefore of the same order of magnitude, differing by approximately 10%. This numerical proximity should not, however, be interpreted as implying that the 21-cm wavelength itself is an average wavelength of broadband astronomical emission. The atomic 21-cm transition has a sharply defined frequency, whereas astronomical observations associated with this transition can occupy broad frequency intervals because of source kinematics, physical conditions, spatial structure, and cosmological redshift.

An important example is provided by J. D. Bowman *et al.* [35], who reported a flattened absorption profile in the sky-averaged radio spectrum centered at approximately:

$$\nu \sim 78 \text{ MHz}$$

with a best-fitting full width at half maximum of approximately:

$$\Delta\nu \sim 19 \text{ MHz}$$

and an amplitude of approximately 0.5 K.

The reported profile was broadly consistent in location with expectations for a redshifted 21-cm signal associated with the first stars. Its best-fitting amplitude, however, was more than a factor of two greater than the largest predictions considered by the authors.

The interpretation of the EDGES profile has subsequently been debated, particularly with respect to foreground modeling and the uniqueness of the extracted absorption signal. The result should therefore be treated here as a reported broad radio-frequency structure rather than as an unambiguous detection of a cosmological 21-cm absorption feature.

Thus, although the underlying 21-cm hyperfine transition has a sharply defined frequency, its astronomical manifestation need not appear as a narrow spectral feature. In cosmological and astrophysical environments, the observed signal can extend over a broad frequency interval.

WUM proposes a fundamentally different physical contribution to this radio-frequency domain.

According to WUM, **ultra-relativistic XIONs can produce broadband radiation through self-annihilation**. The characteristic XION rest-energy scale establishes the fundamental microscopic energy, while the ultra-relativistic motion of XIONs produces a distribution of observed photon energies. Consequently, WUM does not require the XION manifestation to appear as a narrow spectral line fixed precisely at the XION rest-energy frequency.

This distinction is important for interpreting broad 21-cm observations.

In 2007, R. Minchin *et al.* reported the system VIRGOH I 21 in association with NGC 4254, characterized by 21-cm emission having a broad velocity width. Conventionally, this radiation is interpreted as neutral-hydrogen 21-cm emission associated with the kinematics and distribution of HI in the system [36].

Within WUM, another interpretation is proposed. The dark component of VIRGOH I 21 is associated with XIONs, and the observed broadband radio emission is proposed to arise from the **self-annihilation of ultra-relativistic XIONs**.

The comparison is therefore not merely between two nearby energies:

$$E_{XION} = 5.2870895 \mu eV$$

and

$$E_{21} \sim 5.87 \mu eV$$

The more significant WUM prediction concerns the **spectral character of the radiation**. A population of ultra-relativistic XIONs possesses a distribution of energies and momenta and can consequently produce broadband radiation rather than an intrinsically narrow monochromatic feature.

This provides a specific observational question: can the spectral width, shape, spatial distribution, and energetics of broad radio-frequency phenomena conventionally associated with the 21-cm domain be quantitatively reproduced by the self-annihilation of ultra-relativistic XIONs?

XION is additionally unusual among the UCPs because WUM assigns it a second and fundamentally different physical role.

Within WUM, XIONs are proposed to participate in the **Le Sage–Fatio mechanism of Gravitation**. Their significance must therefore be tested not only through radio-frequency observations but also through the consistency of their microscopic properties with the macroscopic gravitational behavior attributed to the Cosmic Medium.

This creates two complementary tests of the same theoretically predicted particle.

First, the predicted XION rest-energy scale and the self-annihilation of ultra-relativistic XIONs must provide a quantitative description of the relevant broadband radio-frequency phenomena.

Second, the same XION population must satisfy the physical requirements imposed by the WUM mechanism of Gravitation.

The XION hypothesis therefore makes a considerably stronger claim than a numerical correspondence between E_{XION} and the characteristic energy of the neutral-hydrogen 21-cm transition. WUM proposes that XIONs provide both a microscopic source of broadband radiation in this energy domain and a constituent of the Cosmic Medium responsible for the proposed Le Sage–Fatio mechanism of Gravitation.

Present status: Radio-domain correspondence accompanied by independent gravitational predictions requiring quantitative tests.

11.8. Observational Status of the Complete Seven-UCP Spectrum

The preceding analysis demonstrates an important distinction between the existence of radiation in a predicted energy domain and the observation of a characteristic spectral structure quantitatively corresponding to a predetermined UCP energy scale.

The seven UCPs should therefore not be assigned identical evidentiary status.

UCF1 provides a particularly clear example. WUM specifies a rest-energy scale of approximately 1.3 TeV, while DAMPE independently reports a characteristic hardening of the cosmic-ray helium spectrum at approximately the same energy. The correspondence concerns a measured spectral structure rather than merely experimental coverage of the TeV domain.

UCF3 provides a different type of evidence. Characteristic X-ray structures have been reported in several physically different astronomical environments near the predicted approximately 3.7-keV scale. These observations are heterogeneous and possess conventional source-specific interpretations, but their repeated occurrence near the same predetermined energy makes the correspondence quantitatively significant.

UCF4 provides perhaps the most highly structured comparison. The test does not depend upon one infrared energy. Six independently observed Unidentified Infrared Bands are related within the WUM interpretation to self-annihilation processes based on one UCF4 rest-energy scale. The observational constraint is therefore multiband rather than single-energy.

ELOP remains a particularly important quantitative target. Its predicted approximately 340-keV rest energy lies in an experimentally accessible hard-X-ray/soft-gamma-ray domain, while symmetric two-photon decay of a single ELOP would produce a characteristic photon energy of approximately 170 keV. A gamma-ray feature near 170 keV has been reported from the direction of the Galactic Center [16]. At present, however, reproducible characteristic structures quantitatively localized at the predicted scales are required before ELOP can be assigned the same observational status as the more quantitatively localized or structured UCF1, UCF3, or UCF4 correspondences.

UCF2 occupies an intermediate position. Its predicted rest energy,

$$E_{UCF2} \sim 9.6 \text{ GeV}$$

is approximately 9.6 GeV. Independent analyses of gamma-ray emission from the Galactic Center and M31 have considered annihilating-particle interpretations involving characteristic particle rest energies in approximately the same 10-GeV domain. Particularly noteworthy is the approximately 11-GeV best-fitting particle rest energy obtained in one multiwavelength analysis of M31. These results provide quantitative correspondence with the predetermined UCF2 scale, but they remain dependent on the adopted astrophysical and particle-annihilation models and therefore do not constitute direct identification of UCF2.

DIRAC and XION provide especially demanding tests.

For DIRAC,

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

lies close to the gamma-ray domain dominated by the broad neutral-pion-decay signature. Energy correspondence alone is therefore unlikely to discriminate reliably between the two mechanisms. DIRAC must instead be tested through additional spectral, environmental, and UCF1–DIRAC couple relationships.

For XION,

$$E_{XION} = 1/2 K_U^6 E_0 = 5.2870895 \mu\text{eV}$$

lies close to the radio-frequency energy domain represented by the neutral-hydrogen 21-cm transition. The conventional hyperfine-transition origin of the 21-cm line is well established, and consequently this numerical proximity cannot by itself identify XION. WUM imposes the additional requirement that XION participate in the proposed Le Sage mechanism of Gravitation. XION must therefore ultimately satisfy both microscopic and macroscopic tests.

The present observational situation is best summarized by stating that **several theoretically specified components of the seven-UCP spectrum possess quantitative observational counterparts, while the remaining components define increasingly specific experimental tests.**

This distinction is fundamental to the scientific evaluation of WUM.

11.9. Heavy–Light UCP Couples as a Stronger Test

The UCP spectrum contains additional structure that cannot be evaluated by treating the seven particles independently.

In particular, WUM predicts two heavy–light couples:

$$E_{DIRAC} = K_U^2 E_{UCF1}$$

and

$$E_{ELOP} = 2/3 K_U^2 E_{UCF2}$$

The conceptual direction of these relationships is important. The light-component rest energies are calculated from those of the heavy components using the fixed Universe Constant K_U .

Thus, WUM does not independently select approximately 1.3 TeV and 70 MeV and subsequently pair them. The theoretically specified UCF1 scale determines the DIRAC scale.

Similarly, the UCF2 scale determines the ELOP scale.

This provides a substantially stronger observational criterion than the detection of four unrelated energies.

For the first couple, Nature must reproduce manifestations associated with:

$$E_{UCF1} \sim 1.3 \text{ TeV}$$

and

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

while remaining consistent with the fixed relationship between them.

For the second couple, the corresponding requirement is:

$$E_{UCF2} \sim 9.6 \text{ GeV}$$

and

$$E_{ELOP} \sim 340 \text{ keV}$$

The most compelling future evidence would therefore be the observation of both members of a couple in the same physical system or in environments connected by the same UCM process.

This couple-based approach is particularly valuable for DIRAC because its energy domain is difficult to distinguish spectroscopically from neutral-pion emission. A correlated UCF1–DIRAC manifestation would provide information that an isolated approximately 70-MeV spectral feature cannot.

11.10. From Individual Correspondences to a System Test

The central observational question posed by WUM is ultimately not whether one can find an astronomical photon with an energy numerically similar to one UCP rest energy.

Such a criterion would be too weak.

The seven UCPs extend from

$$E_{XION} = 5.2870895 \mu\text{eV}$$

to

$$E_{UCF1} \sim 1.3 \text{ TeV}$$

spanning more than seventeen orders of magnitude.

Within this enormous interval, WUM specifies discrete particle rest energies, heavy–light relationships governed by K_U , proposed annihilation products, contributions to UCM Cores and shells, participation in UARs, generation of Ordinary Matter, and, for XION, a proposed microscopic mechanism of Gravitation.

These requirements progressively constrain the hypothesis.

A successful observational test must therefore move through three stages.

First, characteristic structures should occur at the predicted individual energy scales.

Second, the relationships among the UCPs—particularly the heavy–light couples—should be reproduced.

Third, the same particle system must remain consistent with the macroscopic physical roles assigned to Universe-Created Matter throughout WUM.

This provides the transition from particle-scale observations to the broader tests of UCM considered in the following sections.

The observational evidence presented in this paper demonstrates that several theoretically specified components of the seven-UCP spectrum possess quantitative counterparts in independent astronomical and cosmic-ray observations. These correspondences occur across widely separated energy domains and include individual spectral structures, multiband relationships, and particle-energy scales inferred from independent astrophysical analyses.

The remaining UCP components define specific observational and experimental tests at predetermined energy scales. Moreover, the UCP hypothesis is constrained not only by the properties of individual particles but also by the theoretically specified relationships among them, including the two heavy–light UCP couples and their proposed physical roles within Universe-Created Matter.

The decisive test of the UCP hypothesis is therefore systemic rather than particle-by-particle alone.

Nature must reproduce the predicted UCP–UCM system as a system.

12. Independent Observational Tests of UCM

Sections 7–11 show that WUM provides several substantially independent ways of testing the existence and physical properties of **Universe-Created Matter**.

These tests examine different manifestations of the same proposed form of Matter. They include the gravitational influence of UCM Cores; the proposed XION-based mechanism of Gravitation associated with the Cosmic Medium; the angular momentum and Rotational Fission of Macroobjects; the energetic activity of UCP Annihilation Reactors; radiation associated with predicted UCP rest energies; the proposed generation of Ordinary Matter; and the correlated signatures of theoretically related UCP couples.

No single manifestation is sufficient by itself to establish the existence of UCM.

A gamma-ray or X-ray feature near a predicted UCP rest energy does not by itself establish the existence of a new particle because conventional physical processes can produce radiation in the same energy region. Similarly, a gravitational effect attributed to nonluminous Matter does not determine the microscopic nature of that Matter. The rotation of an astronomical structure does not by itself demonstrate the existence of UCPs, and the internal heating of a Macroobject does not uniquely identify an active UAR.

The WUM hypothesis becomes substantially more restrictive when several such phenomena are required to arise from the **same physical UCM system**.

For example, a nonluminous gravitating Core interpreted as a concentration of UCM should not be considered only through its gravitational influence. The same environment can also be examined for radiation associated with predicted UCP rest energies, energetic particles expected from UAR activity, rotational properties associated with the intrinsic angular momentum of UCP ensembles, and physical products predicted to result from UCP interactions and annihilation.

The evidentiary significance increases further for UCP couples. If two particles whose rest energies are theoretically related within WUM produce corresponding signatures in the same or physically connected astrophysical environments, their combined observation provides a more restrictive test than either energy correspondence considered independently.

The strongest observational strategy is therefore to search for **convergence among independent manifestations of UCM**. Gravitational behavior, rotational properties, internal energetic activity, particle-specific radiation, predicted particle products, and theoretically related UCP signatures should be examined together whenever observations permit.

Such convergence is important because these phenomena are measured by different observational methods and probe different physical properties. Agreement among them would reduce the **likelihood** that an apparent correspondence with WUM results from an accidental numerical coincidence or from the interpretation of a single unexplained spectral feature.

Conversely, the same strategy provides a means of testing and potentially falsifying the Model. If an astrophysical object is identified as a candidate UCM Core on gravitational grounds but sufficiently sensitive observations consistently fail to reveal additional physical manifestations specifically predicted for such a

Core, the UCM interpretation would be constrained. Similarly, failure to find correlated signatures of theoretically related UCP couples at the sensitivity required to detect the predicted phenomena would weaken the corresponding coupled particle hypothesis.

The XION hypothesis provides another example of this requirement. Within WUM, XION is connected both with the microscopic properties of the Cosmic Medium and with the macroscopic phenomenon of Gravitation. A successful test must therefore go beyond identifying **radio-frequency phenomena in the same predicted energy domain**. It must determine whether the proposed XION population can be connected quantitatively with both its predicted radio-frequency manifestations and the gravitational behavior attributed to the Cosmic Medium.

The central observational question can therefore be stated directly:

Can one internally consistent UCM framework account quantitatively for several substantially independent phenomena that would otherwise appear observationally unrelated?

This question is more demanding than asking whether any individual observation can be interpreted within WUM. It requires the microscopic UCP spectrum, the physical properties of the Cosmic Medium, and the macroscopic behavior of Universe-Created Matter to describe the same physical systems consistently.

The decisive test of UCM is therefore not an isolated observation but the **convergence of independent quantitative evidence**.

The following section extends this requirement to the complete UCP–UCM system.

13. Complete UCP–UCM System as the Critical Test

No individual observation discussed in this paper is sufficient to establish the existence of Universe-Created Particles.

Known astrophysical processes can produce gamma rays, X rays, infrared and radio emission, energetic particles, and gravitational effects. Consequently, correspondence between a single predicted UCP rest energy and a single observed phenomenon cannot provide a decisive test of the hypothesis.

The critical test is the **complete UCP–UCM system**.

The seven Universe-Created Particles proposed by WUM span more than seventeen orders of magnitude in characteristic rest energy, extending from

$$E_{XION} = 5.2870895 \mu eV$$

to the approximately 1.3-TeV domain of UCF1. Between these extremes lie UCF4 in the electronvolt domain, UCF3 in the kiloelectronvolt domain, ELOP in the sub-MeV domain, DIRAC in the MeV domain, and UCF2 in the GeV domain.

These particles are not introduced as seven independent explanations for seven unrelated observations.

Within WUM, they constitute a single multicomponent physical system whose properties and relationships arise from the fundamental principles of the Model.

This distinction is essential to the evidentiary argument of the present paper. An isolated correspondence between a predicted particle rest energy and an observed spectral feature may be accidental or may result from a known physical process. The hypothesis becomes progressively more constrained when several

independently predicted UCP rest energies are required to have observational counterparts in physically appropriate environments.

The test becomes stronger when the internal relationships of the UCP system are also considered. In particular, WUM predicts two UCP couples whose members occupy widely separated energy domains. For these couples, the light-component rest energy is calculated from the heavy-component rest energy according to

$$E_{light} = K_U^2 \times E_{heavy}$$

Thus,

$$E_{DIRAC} = K_U^2 \times E_{UCF1}$$

and

$$E_{ELOP} = 2/3 K_U^2 \times E_{UCF2}$$

The members of these couples are therefore not independent energy assignments. Evidence for both members of a theoretically predicted couple in the same or physically connected astrophysical environments would provide a substantially more demanding test than either energy correspondence considered independently.

The UCP spectrum must also be consistent with the macroscopic properties attributed to Universe-Created Matter. UCPs are proposed to **constitute the UCM component of the Cosmic Medium**, form Cores and shells of Macroobjects, carry intrinsic angular momentum, participate in Rotational Fission, participate in the operation of **UCP Annihilation Reactors**, generate radiation and energetic particles, participate in the generation and structure of Ordinary Matter, and, in the case of XIONs, provide the microscopic physical basis for the Le Sage mechanism of Gravitation.

The complete test of WUM therefore requires consistency among its fundamental relationships, the predicted rest energies of the seven UCPs, the theoretically determined relationships among UCP couples, the observed radiation spectra, the proposed particle products, the physical properties of the Cosmic Medium, the gravitational behavior of UCM structures, the angular momentum and Rotational Fission of Macroobjects, the activity of UARs, and the astrophysical environments in which these phenomena occur.

Agreement in one category may be accidental. Agreement among several substantially independent categories is considerably more restrictive.

The same requirement makes the hypothesis falsifiable. If observations of sufficient precision and sensitivity systematically fail to reproduce predicted UCP energy scales, if the members of predicted UCP couples fail to exhibit the theoretically required relationships, or if candidate UCM structures consistently lack additional physical manifestations specifically predicted by WUM, the corresponding elements of the UCP-UCM hypothesis would be constrained or rejected.

Conversely, the evidentiary significance would increase substantially if multiple independently predicted UCP rest-energy scales were observationally supported together with their theoretically required relationships, expected particle products, astrophysical environments, and macroscopic UCM manifestations.

The observational burden placed upon WUM can therefore be stated in one sentence:

Nature must reproduce the predicted UCP-UCM system as a system.

This is the critical test of the Universe-Created Particle hypothesis.

14. Conclusion

The purpose of this paper has been to examine the hypothesis of **Universe-Created Particles (UCPs)** as a fundamental physical component of the World–Universe Model and to confront their theoretically specified properties with available observational evidence.

The central proposition of WUM is that Matter is not a primordial substance that must simply be assumed as an initial condition. The Eternal Universe continuously generates **Universe-Created Matter (UCM)** within the expanding four-dimensional Nucleus through the formation of Universe-Created Particles. UCPs constitute a discrete multicomponent physical system with definite rest energies, rather than an unspecified invisible component introduced solely to reproduce gravitational phenomena.

The complete UCP system considered in this paper contains seven particles extending from the $5.2870895 \mu\text{eV}$ domain to the TeV domain:

XION, UCF4, UCF3, ELOP, DIRAC, UCF2, UCF1

Their rest energies span more than seventeen orders of magnitude.

This enormous energy interval is important because the seven values are not introduced independently to fit seven unrelated observations. They arise within one theoretical framework governed by the fundamental rest-energy scale E_0 , the Universe Constant K_U , and the relationships among individual components.

Two heavy–light couples provide an especially restrictive structure:

$$E_{\text{DIRAC}} = K_U^2 \times E_{\text{UCF1}}$$

$$E_{\text{ELOP}} = 2/3 K_U^2 \times E_{\text{UCF2}}$$

The conceptual direction of these relationships is essential: the rest energies of the light components are calculated from those of the corresponding heavy components. They are not independently adjusted parameters.

XION is connected to the same fundamental system through

$$E_{\text{XION}} = 1/2 K_U^6 E_0 = 5.2870895 \mu\text{eV}$$

The observational analysis performed in this paper deliberately distinguishes three levels that should not be confused:

- (1) A predicted energy scale may lie within an experimentally accessible domain.
- (2) A characteristic observed spectral structure may correspond quantitatively to that predicted scale; and
- (3) Direct experimental identification of the proposed particle represents a still stronger requirement.

Among the seven UCPs, **UCF1, UCF3, and UCF4 presently provide particularly structured quantitative observational correspondences of different types.**

For UCF1, the WUM rest-energy scale of approximately

$$E_{\text{UCF1}} \sim 1.3 \text{ TeV}$$

corresponds to the characteristic hardening of the cosmic-ray helium spectrum reported by DAMPE at

approximately the same energy. Independent measurements establish that spectral hardening in cosmic-ray nuclei is a genuine physical phenomenon rather than merely experimental coverage of the TeV domain.

For UCF3,

$$E_{UCF3} \sim 3.7 \text{ keV}$$

several independent X-ray observations of physically different astronomical environments have reported characteristic spectral structures in approximately the same energy region. These observations include different types of features and possess conventional source-specific interpretations. Nevertheless, their repeated occurrence near the theoretically specified UCF3 scale makes the correspondence worthy of continued quantitative investigation.

UCF4 provides a particularly restrictive multiband comparison. Starting from a single approximately

$$E_{UCF4} \sim 0.2 \text{ eV}$$

rest-energy scale, the proposed UCF4 self-annihilation framework reproduces the characteristic energies associated with six independently observed Unidentified Infrared Bands near

$$3.3, 6.2, 7.7, 8.6, 11.2, 12.7 \mu m$$

The significance of this result lies not in a single infrared coincidence but in the reproduction of an entire family of discrete astronomical bands within one particle framework.

ELOP provides an additional specific observational target at its predicted approximately 340-keV rest-energy scale. Hard-X-ray spectral hardening has been observed in large solar flares, including environments of particular interest within the WUM interpretation of UCP Annihilation Reactors. In addition, if a single ELOP undergoes symmetric two-photon decay, the corresponding characteristic photon energy would be approximately 170 keV, a domain in which a gamma-ray feature has been reported from the direction of the Galactic Center. A decisive ELOP test requires reproducible characteristic spectral structure quantitatively localized near the predicted approximately 340-keV rest-energy scale and/or the derived approximately 170-keV photon-energy scale.

UCF2 occupies an intermediate evidentiary position. Its predicted rest energy,

$$E_{UCF2} \sim 9.6 \text{ GeV}$$

lies within characteristic gamma-ray structures observed in several astrophysical environments. Particularly interesting is the approximately 11-GeV best-fitting particle rest energy obtained in one multiwavelength analysis of M31 under an annihilating-particle interpretation.

DIRAC remains an especially demanding experimental problem. Its predicted rest energy,

$$E_{DIRAC} \sim 70.025 \text{ MeV}$$

lies close to the characteristic gamma-ray domain produced by neutral-pion decay. Because realistic astrophysical pion emission forms a broad spectrum, energy correspondence alone is unlikely to provide a decisive discrimination between the two mechanisms. DIRAC should therefore be tested as part of the theoretically connected UCF1–DIRAC system rather than through an isolated search for a 70-MeV feature.

XION presents another fundamentally different test. Its predicted rest energy lies near the radio-frequency energy domain represented by the neutral-hydrogen 21-cm transition. Since the conventional hyperfine-

transition interpretation of the 21-cm line is well established, this proximity alone cannot identify XION. WUM imposes the additional and much stronger requirement that XION participate in the proposed **Le Sage mechanism of Gravitation**. A successful XION test must therefore connect microscopic particle properties with macroscopic gravitational phenomena.

The observational evidence presented in this paper demonstrates that several theoretically specified components of the seven-UCP spectrum possess quantitative counterparts in independent astronomical and cosmic-ray observations. These correspondences occur across widely separated energy domains and include individual spectral structures, multiband relationships, and particle-energy scales inferred from independent astrophysical analyses.

The remaining UCP components define specific observational and experimental tests at predetermined energy scales. Moreover, the UCP hypothesis is constrained not only by the properties of individual particles but also by the theoretically specified relationships among them, including the two heavy-light UCP couples and their proposed physical roles within Universe-Created Matter.

The decisive test of the UCP hypothesis is therefore systemic rather than particle-by-particle alone.

Nature must reproduce the predicted UCP-UCM system as a system.

14.1. UCM and the Energy Content of the World

UCPs constitute Universe-Created Matter, which is proposed to account for approximately **92.8% of the total energy density of the World** at all cosmological times.

The Observable World is divided between the **Cosmic Medium**, containing two-thirds of the total energy density, and **Macroobjects**, containing one-third. Within this total distribution, approximately **92.8%** of the World's energy density is associated with Universe-Created Matter, while the remaining approximately **7.2%** is associated with Ordinary Matter and radiation.

This distinction connects the microscopic UCP spectrum with the macroscopic structure and total energy content of the World.

The Cosmic Medium begins physically with the emergence of UCF1. Before the appearance of Matter capable of constituting the Cosmic Medium, there is no Matter-filled physical Medium in the WUM sense. The fundamental scales: a and t_0 , can be mathematically extrapolated to smaller radius and earlier time, but they do not themselves constitute the physical Cosmic Medium.

This leads to one of the central principles developed in this paper:

An empty physical World is not the physical arena of WUM; the Cosmic Medium itself is constituted by Matter.

Physical properties conventionally assigned to an independent spacetime background are therefore treated differently in WUM. Physical Space, physical Time, Gravitation, and gravitational properties emerge in relation to the Matter-filled Cosmic Medium.

Within this framework, XIONs are proposed to participate in the microscopic mechanism of Gravitation, while the evolving state of the Cosmic Medium is connected with the cosmological parameter

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

Thus, the UCP hypothesis is simultaneously a particle hypothesis and a hypothesis concerning the physical constitution of the World.

14.2. UCPs, Macroobjects, and Angular Momentum

Universe-Created Matter is not restricted to a homogeneous Cosmic Medium.

A substantial fraction of UCM is concentrated in Cores and shells of Macroobjects. These UCM structures play a central role in the formation and evolution of astronomical systems.

Ensembles of UCPs carry intrinsic angular momentum, physically resembling microscopic “air vortices.”

Within WUM, angular momentum is therefore not treated merely as a secondary property acquired after the formation of astronomical structures. It is inherent in the UCP content from which those structures develop.

Overspinning UCM Cores undergo Rotational Fission. This process is proposed as a fundamental mechanism for the formation of Luminous Galaxies and Extrasolar Systems and provides a physical route for transferring angular momentum from parent structures to their descendants.

Consequently, the particle-scale properties of UCPs, the internal constitution of Macroobjects, and the large-scale organization of astronomical systems are different manifestations of the same UCM framework.

14.3. UCP Annihilation Reactors and the Generation of Ordinary Matter

In WUM, UCM Cores of Macroobjects are not passive concentrations of invisible Matter. They function as **UCP Annihilation Reactors (UARs)** supplied continuously with Universe-Created Particles.

Within these Cores, UCP annihilation and transformation processes are proposed to generate energy, radiation, energetic particles, and Ordinary Matter.

This provides another connection between the microscopic UCP spectrum and observable astrophysical phenomena.

The proposed roles of individual UCPs are not identical.

UCF1 annihilation is proposed to participate in the generation of protons and electrons.

DIRACs are proposed to be dipoles of Dirac magnetic monopoles, with DIRAC-related processes generating monopoles together with electrons and positrons.

ELOPs are proposed to be dipoles of preons carrying electric charge $e/3$, with the resulting preons participating in the structure of atomic nuclei.

Thus, Ordinary Matter is not introduced into WUM as a completely separate primordial substance. It arises through physical processes involving Universe-Created Matter.

This is one of the most important conceptual consequences of the UCP hypothesis.

14.4. The Complete UCP–UCM System as the Test of WUM

The evidentiary strength of WUM cannot ultimately be determined from any single gamma-ray feature, X-ray line, infrared band, radio-frequency correspondence, or cosmic-ray spectral break.

Individual correspondences are important because they test predetermined quantitative predictions.

But the more restrictive test is their **convergence**.

Nature must reproduce discrete UCP energy scales.

It must reproduce the relationships among those scales.

It must reproduce the heavy–light UCP couples.

It must reproduce the proposed distribution of UCM within the Cosmic Medium and the Cores and shells of Macroobjects.

It must account for the angular momentum and evolution of UCM-containing Macroobjects.

It must provide the physical conditions required for UCP Annihilation Reactors.

It must reproduce the proposed generation of Ordinary Matter.

And the lowest-energy component, XION, must remain consistent with the proposed physical mechanism of Gravitation.

These requirements transform the UCP hypothesis from a collection of individual particle proposals into an interconnected physical theory.

A failure of sufficiently precise observations to reproduce one of the essential predicted relationships would therefore challenge not merely one numerical correspondence but part of the interconnected WUM structure.

Conversely, continued independent **observational support for theoretically related components** would progressively reduce the likelihood that the observed correspondences result from accidental numerical agreement.

The decisive question is therefore not:

Can one observation be interpreted as evidence for one UCP?

The more important question is:

Can Nature reproduce the complete theoretically interconnected UCP–UCM system?

This is the principal experimental challenge that follows from the present work.

14.5. Resolving the Chicken-and-Egg Problem

We can now return to the fundamental question with which this paper began:

Where did Matter come from?

In conventional cosmological descriptions, the evolution of Matter and radiation can be followed from extremely early stages of the observable Universe. Such descriptions can be extraordinarily successful in describing how an already existing physical system evolves.

The question considered in WUM is different.

What is the physical origin of Matter itself?

WUM distinguishes between the **Eternal Universe** and the **World of finite cosmological age**.

The Eternal Universe does not begin with the World. It continuously generates Universe-Created Matter within the expanding four-dimensional Nucleus through the formation of Universe-Created Particles.

The appearance of UCF1 marks the beginning of the Matter-filled Cosmic Medium. From that point onward, the Cosmic Medium continues to develop through the continuing generation of UCM and the subsequent

generation of Ordinary Matter. UCPs participate in the formation of UCM Cores and Macroobjects, undergo annihilation and transformation in UCP Annihilation Reactors, and participate in the generation of Ordinary Matter.

In this picture, the origin of Matter, the origin of the Cosmic Medium, and the emergence of the physical properties of the World are not separate initial assumptions. They are different aspects of one continuing physical process.

The Chicken-and-Egg Problem is therefore resolved within WUM by removing the requirement that pre-existing Matter within the World be invoked to explain the origin of Matter.

Matter does not arise from previously existing Matter inside the World.

Its source is the Eternal Universe.

The World evolves because the process of Matter creation continues throughout its cosmological history.

This brings the argument of the present paper back to its starting point and, at the same time, defines the foundation for the further systematic development of World–Universe Cosmology.

Nature must reproduce the predicted UCP–UCM system as a system.

Matter is continuously created by the Eternal Universe in the form of Universe-Created Particles.

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