Establishing Physical Parameters within the Framework of World-Universe Cosmology

Vladimir S. Netchitailo
netchitailo.vs@gmail.com

Abstract

Hypersphere World-Universe Cosmology (WUC) offers a new perspective on the Observable World and the discipline of Cosmology. Rooted in Classical Physics, WUC challenges fundamental assumptions in both cosmology and physics. Rather than claiming to account for all available data or provide a fully finalized theory, WUC establishes a foundation for the *New Cosmology* anticipated by Paul Dirac in 1937. While further refinement by the global physics community is essential, WUC's principles—together with groundbreaking discoveries from the James Webb Space Telescope (JWST) and Dirac's enduring vision—highlight the urgent need for a transformative shift in Astronomy, Cosmology, and Classical Physics.

1. Introduction. Classical Physics before Quantum Physics [1]

The concept of **Aether** was first introduced by I. Newton in 1675. Following the work of T. Young (1804) and A.-J. Fresnel (1816), light was understood as a transverse wave propagating through an elastic medium called *Luminiferous Aether*. Since elastic matter of an ordinary type can only transmit longitudinal waves, the unique properties of Aether attracted attention. In 1846, J. McCullagh proposed a theory of a rotationally elastic medium in which the energy of deformation depends only on the rotation of volume elements, not on their compression or distortion. His formulation produced equations analogous to Maxwell's equations, showing that such a medium could transmit transverse waves. However, the concept of Luminiferous Aether was abandoned with the advent of Special Relativity in 1905.

Le Sage's Theory of Gravitation, first suggested by N. Fatio de Duillier in 1690 and later by Le Sage (1748), offered a kinetic explanation of Newtonian gravity. The theory proposed that streams of unseen particles (ultra-mundane corpuscles) impinge on matter from all directions, with bodies partially shielding one another and thereby creating a net attractive force. This was the first theory to describe gravity as an *emergent phenomenon*.

The **Kinetic Theory of Gases** explained macroscopic properties—pressure, temperature, viscosity, thermal conductivity—through the motion of molecules. In 1859, J.C. Maxwell derived the Maxwell velocity distribution, the first statistical law in physics, showing that the macroscopic behavior of gases emerges from microscopic motion.

Maxwell's Equations (1861) unified electricity and magnetism. By comparing the electrodynamic constant c, measured by Weber and Kohlrausch in 1857, with Fizeau's 1849 measurement of light's velocity, Maxwell identified light as an electromagnetic phenomenon.

The **Rydberg Constant** (R_∞), first introduced in 1888 as a fitting parameter for hydrogen spectra, remains one of the most precisely determined physical constants.

The **electron charge-to-mass ratio** (e/m_e), denoted here as $R_T \equiv e/m_e$ was first determined by J.J. Thomson in 1897, a milestone since the electron's mass could not be directly measured.

The **Planck Constant** (h), derived in 1901 from black-body radiation studies, was based on **statistical thermodynamics**, prior to the establishment of quantum mechanics. Using Boltzmann's entropy formula ($S = k_B lnW$, k_B is the Boltzmann constant), Planck introduced h as **a factor that converts units of frequency ν into units of energy E**. He calculated the value of h that is within 1.2% of the currently accepted value.

2. Fundamental Physical Constants [2]

Based on experimentally measured values of constants R_∞, R_T, c, h, and the value of the magnetic permeability of free space: $\mu_0 = 4\pi \times 10^{-7}\ H/m$, we derive the key Fundamental Physical Constants:

- Basic size unit a:

$$a = 0.5\left[(2\,\mu_0 h/c)^3\, R_\infty R_T^6\right]^{1/5} = 1.7705641 \times 10^{-14}\ m$$

- Dimensionless Rydberg constant α:

$$\alpha = (2aR_\infty)^{1/3}$$

The constant α was later named "Sommerfeld's constant" and later "Fine-structure constant."

- Electron rest energy E_e:

$$E_e = \alpha hc/a$$

- Elementary charge e:

$$e^2 = 2\alpha h/\mu_0 c$$

All of these constants were determined or could have been calculated *prior to the development of Quantum Physics*.

3. World-Universe Cosmology

World-Universe Cosmology (WUC) is founded on three central concepts:

- **Cosmic Medium (CM):** the carrier of all interactions in Classical Physics.
- **Universe-Created Matter (UCM):** continuously generated by the Eternal Universe.
- **Angular Momentum:** inherited from the Eternal Universe.

The purpose of this paper is to demonstrate how Physical Constants and Major Cosmological Parameters naturally emerge within WUC.

4. Why Four Spatial Dimension Observable World [3]

To address the absence of a physical "center of expansion" in three-dimensional cosmology—often associated with the *initial singularity*—WUC introduces the concept of the **Hypersphere World** embedded in four spatial dimensions. In this framework, the center of expansion resides at the center of the **4D Nucleus**.

- The expansion of the Nucleus stretches its 3D surface, which constitutes the Hypersphere World. Thus, there is no need to invoke *dark energy*.
- The continuous creation of matter arises naturally from the Nucleus's expansion in the fourth spatial dimension. UCM is produced homogeneously throughout Hypersphere World.
- In WUC, all major cosmological parameters of Observable World depend on the dimensionless time-varying quantity: $Q = R/a$, where R is the World's radius and a is the basic size unit. Quantity Q encapsulates the curvature of the World in fourth spatial dimension and serves as a fundamental scaling parameter.

5. Energy Density of the Observable World

In WUC, the Observable World (OW) is described as a **Hubble Bubble (HB)** with radius $R = c\tau$, where c is the gravitodynamic constant (identical to the electrodynamic constant in Maxwell's equations) and τ is the **Absolute Time.** The OW has an intrinsic surface energy density $\sigma_0 = hc/a^3$ interpreted as a temperature-invariant surface enthalpy [4].

Following Nikola Tesla's principle — *"There is no energy in matter other than that received from the*

environment" — the total energy of OW is:

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

The corresponding average energy density is:

$$\rho_{OW} = 3\sigma_0/R = 3\rho_0 \times Q^{-1}$$

which decreases inversely with radius R. Here, $\rho_0 = hc/a^4$ is the fundamental energy density unit, and

$$Q = R/a = A_\tau/t_0$$

where A_τ is the Absolute Age of the World and $t_0 = a/c = 5.9059662 \times 10^{-23}\ s$ is the basic time unit. Thus, Q is equivalent to **Dirac's Large Number**.

UCM is continuously generated by the Eternal Universe within the expanding 4D Nucleus. This occurs through the formation of **Universe-Created Particles (UCPs)**, which annihilate in pairs to form ordinary particles. UCPs carry angular momentum resembling microscopic "air vortices." The rate of UCM creation is proportional to the surface area of the Hubble Bubble.

The surface energy density σ_0 can also be expressed as an **angular momentum flux density**:

$$J_h = h/a^2 t_0$$

so that the total energy of the OW is equivalent to the **total angular momentum flux**:

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

directed along the fourth spatial dimension.

In summary, WUC reduces the World to two fundamental parameters:

- the dimensionless Rydberg constant $\alpha = (2aR_\infty)^{1/3}$.
- the time-varying quantity Q.

The principle follows that *the best theory is the one constructed from the fewest possible dimensionless parameters*.

6. Critical Energy Density

The principal idea of WUC is that the energy density of OW, ρ_{OW} equals to a critical energy density ρ_{cr}, which can be found by considering a sphere of radius R_M and enclosed mass M that can be calculated by multiplication of critical mass density by the volume of the sphere. When OW has the critical density, the Hubble velocity $H \times R_M$ ($H = c/R$ is the Hubble parameter and R is a radius of OW) equals the escape velocity v_{esc}:

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

which gives an equation for ρ_{cr}:

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

This equation can be rewritten as:

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

where $\mu_g = \frac{4\pi G}{c^2}$ is a gravitomagnetic parameter and $\rho_{CM} = \frac{2}{3}\rho_{cr}$ is an energy density of CM.

Considering that $H \propto R^{-1}$, it is easy to see the gravitational parameter $G \propto R^{-1}$. We emphasize that the values of the main cosmological parameters G and H depend on the value of ρ_{CM} which is the characteristic of CM that is homogeneous and isotropic.

According to WUC, the critical energy density of OW ρ_{cr} equals to ρ_{OW}:

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

From this equation we can get the following expression for the gravitational parameter G:

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

7. Inter-Connectivity of Primary Cosmological Parameters [5]

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

WUC holds that there indeed exist relations between all Cosmological parameters that depend on dimensionless time-varying quantity Q. According to WUC, the following parameters of OW depend on Q:

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

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

where a basic energy unit E_0 equals to: $E_0 = hc/a$. In frames of WUC, all these Cosmological parameters are a manifestation of the Worlds' curvature in the fourth spatial dimension.

8. Directly Measured Cosmological Parameters

There are only two directly measured Cosmological parameters: the Gravitational parameter G and the Temperature of the Cosmic Microwave Background Radiation (MBR) T_{MBR}. Q. Li, *et al.* experimentally measured the most accurate values of G using two independent methods [6]

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

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

which are in excellent agreement with the value of $G = 6.67420 \times 10^{-11} m^3 kg^{-1} s^{-2}$ predicted by WUC in 2013 [4]. In 2009, D. J. Fixsen measured the value of MBR temperature T_{MBR} [7]:

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

It means that the most accurate parameter is G, and all other Cosmological parameters could be, in principle, calculated based on the value of G with the same accuracy. Thanks to the revealed by WUC Inter-Connectivity of Cosmological parameters, we show that G that can be measured directly makes measurable all Cosmological parameters, which cannot be measured directly.

9. Gravitational Parameter G and Dirac's Large Number Q

Considering equations in Section 3, we have the following equation for G:

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

An average value of Gravitational parameter G_{av} of experimentally measured values by Q. Li, *et al.* [6]:

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

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

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

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

Leveraging Inter-Connectivity of primary cosmological parameters revealed by WUC, we demonstrate that the gravitational parameter G_{av}, which can be measured directly, enables the determination of all other cosmological parameters that are not directly measurable. Using G_{av}, we calculate the radius of the curvature R as follows:

$$G_{av} \rightarrow Q_{av} \rightarrow R = a \times Q_{av} = 1.3459{\times}10^{26}\ m\,.$$

10. Hubble's Parameter and Age of the World

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

$$H_0 = \frac{8\pi hc}{a^3c^3} \times G_{av} = 68.733\ km\ s^{-1} Mpc^{-1}$$

$$A_\tau = \frac{1}{H_0} = \frac{a^3c^3}{8\pi hc} \times G_{av}^{-1} = 14.226\ Byr$$

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

According to WUC, the value of H should be measured based on MBR only. The calculated value of the Hubble's parameter in 2013: $H_0 = 68.733\ km\ s^{-1} Mpc^{-1}$ is in excellent agreement with the most recent measured value in 2021: $H_0 = 68.7 \pm 1.3\ km\ s^{-1} Mpc^{-1}$ using only MBR data.

11. Temperature of MBR and Electron-to-Proton Mass Ratio

Considering the equation in Section 3 for T_{MBR}:

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

we have the following equation for m_e/m_p:

$$\frac{m_e}{m_p} = \frac{2\pi^3}{15\alpha}\left(\frac{k_B T_{MBR}}{E_0}\right)^4 \times Q_{av}$$

12. There is no Cosmic Medium – There is Nothing [8]

WUC, being a classical model, introduces classical notions only from the moment the first ensemble of particles emerged at the Absolute time $\tau \gtrsim t_0 \times \alpha^{-2} \cong 10^{-18}\, s$, which defined by the value of $Q \gtrsim \alpha^{-2} \cong 18{,}780$. **Time, Space**, and **Gravitation** are intrinsically linked to the Impedance $Z_g = \mu_g c$, the Gravitomagnetic parameter μ_g and the energy density of CM ρ_{CM}, respectively. Consequently, Time, Space, and Gravitation cannot be discussed independently of CM.

In frames of WUC, μ_g can be calculated based on the value of ρ_{CM}:

$$\mu_g = \frac{4\pi G}{c^2} = \frac{\rho_{CM}}{c^2} \times P^2$$

where a dimension-transposing parameter P equals to:

$$P = \frac{a^3}{2h/c}$$

The gravitational parameter G equals to:

$$G = \frac{\rho_{CM}}{4\pi} \times P^2$$

Using a substantial degree of freedom when it comes to choosing the dimension of "mass," we multiply the mass by P and divide Z_g by P. Following this approach, we find the gravitomagnetic parameter of CM μ_{CM}:

$$\mu_{CM} = \frac{4\pi G}{Pc^2} = \frac{1}{R}$$

and the impedance of the Cosmic Medium Z_{CM}:

$$Z_{CM} = \mu_{CM} c = \frac{c}{R} = H = \tau^{-1}$$

Gravity, under WUC, is not an interaction but rather a manifestation of CM. This perspective aligns with Le Sage's theory of gravitation, which, in WUC, is based on UCPs, referred to as XIONs ($5.3\ \mu eV$). The energy density of CM constitutes two-thirds of the total energy density of OW.

All physical laws are determined by CM, which is both homogeneous and isotropic. Indeed, **CM emerges as the cornerstone of Classical Physics – a savior of its principles**. Let us not discard this profound concept with the tide of modernity: **we must not throw the baby out with the bathwater**!

Physical parameters corresponding to the characteristics of the Eternal Universe and CM are depicted in **Table 1.** Analysis of this table shows that all major physical parameters determine by their characteristics.

13. Conclusion

WUC demonstrates that the **fundamental physical constants** and the **major cosmological parameters** of the Observable World can be derived from a minimal foundation. The dimensionless Rydberg constant, $\alpha = (2aR_\infty)^{1/3}$ and the time-varying scaling factor, $Q = R/a$ form the backbone of the model:

- Absolute Age, Hubble parameter, critical energy density, and other major cosmological parameters emerge naturally from these quantities, rather than being introduced as adjustable inputs.
- The framework avoids the need for speculative constructs such as **dark energy**, **inflation**, or an **initial singularity**, replacing them with physically grounded mechanisms rooted in the expansion of a four-dimensional Hypersphere World.
- Comparisons with observational data — including Hubble measurements and CMB-derived cosmological parameters — show strong agreement with WUC predictions.

Thus, WUC offers a predictive, coherent, and testable alternative to the standard Big Bang Model, based on classical physics principles and a minimal set of dimensionless parameters.

Table 1. Physical parameters in WUC corresponding to the characteristics of the Eternal Universe and CM.

Characteristic of the Eternal Universe and CM	Physical parameter
Creation of 4D Nucleus with extrapolated radius a	Basic size unit, a
Creation of UCPs with rest energy $\alpha^n \times E_0$	Basic energy unit, E_0, constant α, $n = -2 \rightarrow 6$
Creation of total energy of Observable World	$E_{OW} = 4\pi E_0 \times Q^2$
Creation of angular momentum with $J_h = h/a^2 t_0$	Basic angular momentum unit, h – Planck constant
Impedance, $Z = \tau^{-1}$	Absolute time, $\tau = Z^{-1}$
Magnetic parameter, $\mu = R^{-1}$	Radius of the Nucleus, $R = \mu^{-1}$
Impedance-to-Magnetic parameter ratio	Gravitodynamic constant, $c = Z/\mu$
Nucleus radius-to-Basic size unit ratio	Dirac's Large Number, $Q = R/a$
Impedance, $Z = \tau^{-1}$	Hubble parameter, $H = Z$
Impedance, $Z = \tau^{-1}$	Absolute Age of the World, $A_\tau = Z^{-1} = \tau$
The World – Hypersphere of 4D Nucleus	Finite volume of the World, $V_W = 2\pi^2 R^3$
Observable World - 3D Hubble's Bubble	Volume of the Observable World, $V_{OW} = \frac{4}{3}\pi R^3$
Energy density $\rho_{CM} = \frac{2E_0}{a^3} \times Q^{-1}$	Gravitational parameter, $G = \frac{\rho_{CM}}{4\pi}$
Electron-Proton Intergalactic plasma	Constant $\alpha = E_e/E_0$
Temperature of microwave background radiation	Electron-to-Proton mass ratio, m_e/m_p

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