We can't solve problems by using the same kind of thinking we used when we created them.

Albert Einstein

5D WORLD – UNIVERSE MODEL

SPACE–TIME–ENERGY

Vladimir S. Netchitailo

Biolase Inc., 4 Cromwell, Irvine CA 92618, USA. v.netchitailo@sbcglobal.net

ABSTRACT

In 1983, Paul S. Wesson developed 5D Space-Time-Mass theory that associates the fifth dimension with rest mass. The gravitational constant serves as the dimension-transposing parameter.

This paper puts the World-Universe Model (WUM) onto the theoretical basis developed by Prof. Wesson, with the following modifications: the fifth dimension is associated with the total energy of the Medium of the World, and the gravitomagnetic parameter of the Medium serves as the dimension-transposing parameter.

1. INTRODUCTION

World – Universe Model (WUM) utilizes the following principles:

Variable gravitational parameter. This hypothesis was proposed by Paul Dirac in 1937 [1].

Continuous creation of matter. A similar idea was proposed by Paul Dirac in 1974 [2]. According to WUM, the World is finite and is expanding inside the Universe which serves as an unlimited source of energy that continuously enters into the World.

Existence of the Medium of the World stated by Nikola Tesla: "*All attempts to explain the workings of the universe without recognizing the existence of the ether and the indispensable function it plays in the phenomena are futile and destined to oblivion*". Unique properties of the Medium were discussed by James McCullagh in 1839. He proposed a theory of a rotationally elastic medium, i.e. a medium in which every particle resists absolute rotation. This theory produces equations analogous to Maxwell's electromagnetic equations [3].

In WUM, the World consists of the Medium (protons, electrons, photons, neutrinos, and dark matter particles) and Macroobjects (Galaxy clusters, Galaxies, Star clusters, Extrasolar systems, planets, etc.) made of these particles. There are no empty space and dark energy in the WUM.

Decisive role of energy postulated by Nikola Tesla: "*There is no energy in matter other than that received from the environment*".

Supremacy of matter postulated by Albert Einstein: "*When forced to summarize the theory of relativity in one sentence: time and space and gravitation have no separate existence from matter*".

Mach's principle. A very general statement of Mach's principle is "*Local physical laws are determined by the large-scale structure of the universe*" [Wikipedia, Mach's principle].

Principal role of Maxwell's Equations (ME) that form the foundation of classical electrodynamics. The value of ME is even greater because J. Swain showed that "*linearized general relativity admits a formulation in terms of gravitoelectric and gravitomagnetic fields that closely parallels the description of the electromagnetic field by Maxwell's equations*" [4]. Hans Thirring pointed out this analogy in his "On the formal analogy between the basic electromagnetic equations and Einstein's gravity equations in first approximation" paper published in 1918 [5]. It allows us to use formal analogies between the electromagnetism and relativistic gravity. It is worth to note that *the equations for Gravitoelectromagnetism were first published in 1893, before general relativity, by Oliver Heaviside as a separate theory expanding Newton's law* [Wikipedia, Gravitomagnetism].

In accordance with Maxwell's equations for electromagnetism and gravitoelectromagnetism there are two measurable physical characteristics: energy density and energy flux density. For all particles under consideration we used four-momentum to conduct statistical analysis of particles' ensembles, obtaining the energy density as the final result.

Fifth dimension. In 1983, Paul S. Wesson suggested that a fifth dimension might be associated with rest mass via $x^4 = Gm/c^2 \propto t$.

WUM follows this idea, albeit associating the fifth dimension with the parameters of the Medium of the World: the gravitomagnetic parameter and the total energy.

Fundamental parameters. Two Fundamental Parameters in various rational exponents define all macro and micro features of the World: Fine-structure constant α and dimensionless quantity Q . While α is constant, Q increases in time, and is in fact a measure of the Size and the Age of the World [6, 7].

WUM is proposed as an alternative to the prevailing Bing Bang Model of standard physical cosmology. The main difference is the source of the World's energy. The Model was developed in [6–14]. A number of results obtained there are quoted in the current work without a full justification; an interested reader is encouraged to view the referenced papers in such cases.

In the present work we focus on the physical meaning of the fifth coordinate and provide an overview of WUM in a new light. In Section 2 we present the historical overview of five-dimensional spacetime theories. A paper "Kaluza-Klein Gravity" by J. M. Overduin and P. S. Wesson provides an excellent review of such theories. In Section 3 we propose a new physical meaning of the fifth coordinate and give a short summary of WUM in a new light.

2. HISTORICAL OVERVIEW

J. M. Overduin and P. S. Wesson have this to say about five-dimensional space-time theories [15]:

"Kaluza's achievement was to show that five-dimensional general relativity contains both Einstein's four-dimensional theory of gravity and Maxwell's theory of electromagnetism. He however imposed a somewhat artificial restriction (the cylinder condition) on the coordinates, essentially barring the fifth one a priori from making a direct appearance in the laws of physics. Kaluza unified not only gravity and electromagnetism, but also matter and geometry, for the photon appeared in four dimensions as a manifestation of empty five-dimensional spacetime.

The world of everyday experience is three-dimensional. Nevertheless, the temptation to tinker with the dimensionality of nature has proved irresistible to physicists over the years. The main reason for this is that phenomena which require very different explanations in three-dimensional space can often be shown to be manifestations of simpler theories in higher-dimensional manifolds. But how can this idea be reconciled with the observed three-dimensionality of space? If there are additional coordinates, why does physics appear to be independent of them?

It is useful to keep in mind that the new coordinates need not necessarily be lengthlike (in the sense of being measured in meters, say), or even spacelike (in regard to their metric signature). A concrete example which violates both of these expectations was introduced in 1909 by Minkowski, who showed that the successes of Maxwell's unified electromagnetic theory and Einstein's special relativity could be understood geometrically if time, along with space, were considered part of a four-dimensional

3

spacetime manifold via $x^0 = ict$. Many of the abovementioned arguments against more than three dimensions were circumvented by the fact that the fourth coordinate did not mark distance. And the reason that physics had appeared three-dimensional for so long was because of the large size of the dimension-transposing parameter c, which meant that the effects of "mixing" space and time coordinates (i.e., length contraction, time dilation) appeared only at very high speeds.

In Minkowski's time, there had already been experimental phenomena (namely, electromagnetic ones) whose invariance with respect to Lorentz transformations could be interpreted as four-dimensional coordinate invariance. No such observations pointed to a fifth dimension. Physics was to take place — for as-yet unknown reasons — on a four-dimensional hypersurface in a five-dimensional universe (Kaluza's "cylinder condition"). No mechanism is suggested to explain why physics depends on the first four coordinates, but not on the extra ones. This dependence (on the new coordinates) *presumably appears in regimes that have not yet been well-probed by experiment — much as the relevance of Minkowski's fourth dimension to mechanics was not apparent at non-relativistic speeds.*

An alternative is to take Minkowski's example more literally and entertain the idea that extra dimensions, like time, might not necessarily be lengthlike. In this case the explanation for the near-cylindricity of nature is to be found in the physical interpretation of the extra coordinates; i.e., in the values of the dimension-transposing parameters (like c) needed to give them units of length. The first such proposal of which we are aware is the 1983 "space-time-mass" theory of Wesson [16], who suggested that a fifth dimension might be associated with rest mass via $x^4 = Gm/c^2 \propto t$. The chief effect of this new coordinate on four-dimensional physics was that particle rest mass, usually assumed to be constant, varied with time. The variation was, however, small and quite consistent with experiment.

Variable gravity theories are, of course, not new ($G \propto t^{-1}$). *What is new in the models just described — and what is important about noncompactified Kaluza-Klein theory in principle — is not so much the particular physical interpretation one attaches to the new coordinates, but the bare fact that physics is allowed to depend on them at all. It is clearly of interest to study the higher-dimensional Einstein equations with a general dependence on the extra coordinates; i.e., without any preconceived notions as to their physical meaning. It allows us to interpret four-dimensional matter as a manifestation of five-dimensional geometry. This has been termed the "induced-matter interpretation" of Kaluza-Klein theory". Metrics which do not depend on x^4 can give rise only to induced matter composed of* (massless) *photons; while those which depend on x^4 give back equations of state for fluids composed of massive particles.*

"Space-Time-Matter (STM) as a theory of 4D matter from 5D geometry was launched in 1992 and developed by a focused group of researches. Unlike Klein and many others since, we avoid overly restrictive assumptions about the physical dimension, scale or topology of the extra coordinates. Dimensional reduction then leaves us with Einstein's field equations as usual, along with extra terms arising solely from the geometry of the higher-dimensional manifold. We identify these extra terms with matter and energy in the four-dimensional world" [17].

3. COSMOLOGY

Let's proceed to discuss the origin, evolution, and parameters of the World speculated by the World – Universe Model (WUM) in a new light of the Space-Time-Matter theory developed by Paul S. Wesson.

WUM is built on two major assumptions: the universality of physical laws and the cosmological principle. The cosmological principle states that on large scale the World is homogeneous and isotropic. WUM envisions an expansion of the World.

3.1. THE BEGINNING AND EXPANSION

About 14.223 billion years ago the World was started by a fluctuation in the Universe, and the Nucleus of the World, which is a 4-ball, was born. The antipode length (the furthest distance between any two points) of the World's Nucleus at the Beginning was equal to

$$a = 2\pi a_0 \qquad\qquad 3.1.1$$

where a_0 is the classical electron radius. The Nucleus has since been expanding through the Universe so that the antipode length is increasing with speed equal to the gravitoelectrodynamic constant c for cosmological time τ and has the length:

$$R = c\tau \qquad\qquad 3.1.2$$

The corresponding diameter of the Nucleus D_N is:

$$D_N = 2R/\pi \qquad\qquad 3.1.3$$

The 4-ball is the interior of a 3-sphere which is the World in our Model. The 3-dimensional cubic hyperarea of a 3-sphere V_W is:

$$V_W = \frac{\pi^2}{4} D_N^3 = \frac{2}{\pi} R^3 \qquad\qquad 3.1.4$$

The extrapolated energy density of the World at the Beginning is much smaller than the nuclear energy density [6, 7].

3.2. THE CREATION OF MATTER

Recall the well-known Friedmann equation for the critical energy density of the World ρ_{cr} :

$$\rho_{cr} = \frac{3H^2 c^2}{8\pi G} \qquad\qquad 3.2.1$$

where G is the gravitational parameter and H is Hubble's parameter:

$$H = \frac{c}{R} = \frac{1}{\tau} \qquad\qquad 3.2.2$$

Equation 3.2.1 can be rewritten as

$$\frac{4\pi G}{c^2} \times \frac{2}{3}\rho_{cr} = \mu_g \times \rho_M = H^2 = \frac{1}{\tau^2} = \frac{c^2}{R^2} \qquad\qquad 3.2.3$$

where μ_g is the gravitomagnetic parameter and $\rho_M = \frac{2}{3}\rho_{cr}$ is the energy density of the Medium. According to Paul Dirac, the gravitational parameter G is proportional to R^{-1} and is decreasing in time as $G \propto \tau^{-1}$ [1]. It means that ρ_{cr} and ρ_M are also proportional to R^{-1} and are decreasing in time as $\rho_M = \frac{2}{3}\rho_{cr} \propto \tau^{-1}$. In frames of WUM the critical energy density equals to [7]:

$$\rho_{cr} = 3\rho_0 \frac{a}{R} = 3\rho_0 \times Q^{-1} \qquad\qquad 3.2.4$$

where ρ_0 is the basic unit of energy density

$$\rho_0 = \frac{hc}{a^4} \qquad\qquad 3.2.5$$

and h is Planck constant. We introduced the dimensionless quantity Q [8] that equals to:

$$Q = \frac{R}{a} = \frac{D_N}{4a_0} = 0.759960 \times 10^{40} \qquad\qquad 3.2.6$$

Amount of energy added to the World from the Universe dE_W is proportional to the increase of the hyperarea of the 3-sphere dV_W :

$$dV_W = \frac{6}{\pi}R^2 dR \qquad\qquad 3.2.7$$

and the energy density of the Medium ρ_M which is the surface energy density of the Nucleus.

The total amount of the World energy at cosmological time τ is thus

$$E_W = \frac{12}{\pi}\rho_0 a \int_0^R r\,dr = \frac{6}{\pi}\rho_0 a R^2 = \frac{6}{\pi}\sigma_0 R^2 \qquad\qquad 3.2.8$$

where constant σ_0 equals to

$$\sigma_0 = \rho_0 a \qquad\qquad 3.2.9$$

The energy density of the World ρ_W is inversely proportional to the Nucleus antipode length R:

$$\rho_W = \frac{6\pi^3 \sigma_0 R^2}{2\pi^3 R^3} = 3\frac{\sigma_0}{R} = \rho_{cr} \qquad\qquad 3.2.10$$

and equals to ρ_{cr} necessary for the flat World at any cosmological time τ . It is important to note that:

- In our calculations we used the measurable Fundamental unit – energy density;
- All physical parameters under consideration depend on Nucleus diameter D_N which is in fact the fifth coordinate in our Model. The quantity Q is the dimensionless value of it. The physical meaning of this coordinate is discussed in the next section.

6

3.3. Physical Meaning of the Fifth Coordinate

According to P. S. Wesson: *"a fifth dimension might be associated with rest mass via $x^4 = Gm/c^2 \propto t$. The chief effect of this new coordinate on four-dimensional physics was that particle rest mass, usually assumed to be constant, varied with time".*

In our opinion the fifth dimension is associated with the parameters of the Medium of the World:

- The gravitomagnetic parameter $\mu_g = 4\pi G/c^2 \propto \tau^{-1}$;
- The energy density $\rho_M \propto \tau^{-1}$;
- The volume $V_W = \frac{\pi^2}{4} D_N^3 = \frac{2}{\pi} R^3 \propto \tau^3$

via:

$$x^4 = \frac{\mu_g}{c^2} \times \rho_M \times V_W = \frac{\mu_g E_M}{c^2} = \frac{V_W}{R^2} = \frac{2}{\pi} R = \frac{2}{\pi} Qa = D_N \propto \tau \qquad 3.3.1$$

where $E_M = \rho_M V_W$ is the total energy of the Medium.

The proposed approach to the fifth dimension is in agreement with Mach's principle: "*Local physical laws are determined by the large-scale structure of the universe*". Applied to WUM it follows that all parameters of the World depending on Q are manifestation of the fifth dimension of the World (see Section 3.4 and Appendix A). The Medium of the World composed of massive particles (protons, electrons, photons, neutrinos, and dark matter particles) is the manifestation of the metric depending on x^4. Rest masses of protons, electrons, and Dark Matter particles don't vary with time.

The physical laws we observe appear to be independent of the fifth coordinate due to the very small value of the dimension-transposing parameter μ_g/c^2.

3.4. Q-Dependent, Time Varying Parameters of the World

The constancy of the universe fundamental constants, including G, Fermi coupling constant G_F, Planck mass M_P, is now commonly accepted, although 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 indirectly from other constants that can be measured more accurately, as is done in some other areas of physics* [Wikipedia, Gravitational constant].

WUM holds that there indeed exist relations between all Q-dependent, time varying parameters. Consequently, the value of Q can be derived from the value of any of these parameters. One way to calculate Q is through the Newtonian parameter of gravitation G. According to WUM [7, 8]

$$G = \frac{ac^4}{8\pi E_0} \times Q^{-1} \qquad 3.4.1$$

Using the commonly accepted value of G

$$G = 6.67384(80) \times 10^{-11} \, m^3 kg^{-1} \, s^{-2} \qquad 3.4.2$$

we calculate Q_G to equal

$$Q_G = 0.760000(91) \times 10^{40} \qquad\qquad 3.4.3$$

Using gravity for calculating the value of Q may not lead to the highest precision. Of all parameters that depend on Q, according to WUM, Fermi coupling parameter G_F

$$\frac{G_F}{(\hbar c)^3} = \left(1800\alpha\frac{m_e}{m_p}\right)^{1/4}\frac{m_p}{m_e}\frac{1}{E_0^2} \times Q^{-1/4} \qquad\qquad 3.4.4$$

is known with the highest precision. Using the commonly accepted value of G_F

$$\frac{G_F}{(\hbar c)^3} = 1.166364(5) \times 10^{-5} GeV^{-2} \qquad\qquad 3.4.5$$

we calculate Q_F to equal

$$Q_F = 0.759960(13) \times 10^{40} \qquad\qquad 3.4.6$$

Notice that the precision is 7 times higher. We can now go back and calculate the value of G to equal

$$G = 6.67420(11) \times 10^{-11}\, m^3 kg^{-1}\, s^{-2} \qquad\qquad 3.4.7$$

Higher precision in measuring any of Q-dependent parameters yields higher precision for all of them. For a complete list of parameters dependent on Q, refer to Appendix A. We propose to introduce Q as a new fundamental parameter tracked by CODATA, and use its value in calculation of all Q-dependent, time varying parameters.

3.5. EXPERIMENTAL PROOF OF THE FIFTH COORDINATE

WUM gives the following explanation of the "Faint young Sun" paradox: all macroobjects of the World were fainter in the past. As their cores absorb new energy, the size of macroobjects R_{MO} and their luminosity L_{MO} are increasing in time $R_{MO} \propto Q^{1/2} \propto \tau^{1/2}$ (see equation 3.4.6) and $L_{MO} \propto Q \propto \tau$ correspondingly [6, 7]. For example, taking the age of the World $\cong 14.2$ Byr and the age of solar system $\cong 4.6$ Byr, it is easy to find that the young Sun's output was 67.6% of what it is today. Literature commonly refers to the value of 70% [18].

Interestingly, Nikola Tesla shared the same opinion. In 1934, "*Dr. Tesla disclosed that he has lately perfected instruments which flatly disprove the present theory of the high physicists that the sun is destined to burn itself out until it is a cold cinder floating in space. Dr. Tesla stated that he is able to show that all the suns in the universe are constantly growing in mass and heat, so that the ultimate fate of each is explosion*" [19].

5D Space-Time-Energy World – Universe Model is the first unified model of the World that successfully describes all of its primary parameters and their relationships, ranging in scale from cosmological structures to elementary particles. The Model allows for precise calculation of values that were only measured experimentally earlier, and makes verifiable predictions. While the Model needs significant further elaboration, it can already serve as a basis for a new physics proposed by Paul Dirac in 1937 and Paul Wesson in 1983.

References

1. P. A. M. Dirac, Nature, **139**, 323 (1937).

2. P. A. M. Dirac, Proc. R. Soc. Lond. **A**, **338**, 439 (1974).

3. J. Mc Cullagh, Transactions of the Royal Irish Academy, **21**, 17 (1839).

4. J. Swain (2010), arXiv: ge-qc/1006.5754.

5. H. Thirring, Physikalische Zeitschrift, **19**, 204 (1918).

6. V. S. Netchitailo, "World - Universe Model. Overview", http://vixra.org/abs/1502.0027.

7. V. S. Netchitailo, "World - Universe Model", http://vixra.org/abs/1303.0077.

8. V. S. Netchitailo, "Fundamental Parameter Q. Recommended Values of the Newtonian Parameter of Gravitation, Hubble's Parameter, Age of the World, and Temperature of the Microwave Background Radiation", http://vixra.org/abs/1312.0179.

9. V. S. Netchitailo, "World - Universe Model with Time Varying Gravitational Parameter", http://vixra.org/abs/1401.0187.

10. V. S. Netchitailo, "World - Universe Model. Fundamental parameters and Units", http://vixra.org/abs/1402.0101.

11. V. S. Netchitailo, "World - Universe Model. Multicomponent Dark Matter. Cosmic Gamma-Ray Background", http://vixra.org/abs/1406.0018.

12. V. S. Netchitailo, "World - Universe Model. Super-Weak Interaction. Sterile Neutrino Dark Matter", http://vixra.org/abs/1406.0179.

13. V. S. Netchitailo, "World - Universe Model. The Summary", http://vixra.org/abs/1411.0079.

14. V. S. Netchitailo, "World - Universe Model. Cosmic Far-Infrared Background", http://vixra.org/abs/1412.0265.

15. J. M. Overduin and P. S. Wesson (1998), arXiv: gr-qc/9805018.

16. P. S. Wesson, Astron. Astrophys., **119**, 145 (1983).

17. P. S. Wesson (Founder), "The 5D Space-Time-Matter Consortium", http://5dstm.org/

18. D. O. Gough, Solar Physics, **74**, 21 (1981).

19. J. W. Alsop, Jr. www.tesla-coil-builder.com/Articles/july_11_1934b.htm

Appendix A

Q in various rational exponents defines all time varying parameters of the World as follows [7, 8]:

- Total Energy of the World
$$E_W = \frac{6}{\pi} E_0 \times Q^2$$

- Age of the World

$$A_\tau = \frac{a}{c} \times Q$$

- Planck mass
$$M_P = 2 \frac{E_0}{c^2} \times Q^{1/2}$$

- Newtonian parameter of gravitation

$$G = \frac{ac^4}{8\pi E_0} \times Q^{-1}$$

- Hubble's parameter

$$H = \frac{c}{a} \times Q^{-1}$$

- Critical energy density

$$\rho_{cr} = 3 \frac{E_0}{a^3} \times Q^{-1}$$

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

- Temperature of the far-infrared background radiation peak
$$T_{FIRB} = \frac{E_0}{k_B} \left(\frac{15}{4\pi^5} \right)^{1/4} \times Q^{-1/4}$$

- Fermi coupling parameter
$$\frac{G_F}{(\hbar c)^3} = \left(1800\alpha \frac{m_e}{m_p} \right)^{1/4} \frac{m_p}{m_e} \frac{1}{E_0^2} \times Q^{-1/4}$$

- Coupling parameters of the Fundamental interactions:
  Gravitational
$$\alpha_G = Q^{-1}$$
  Weak
$$\alpha_W = Q^{-1/4}$$
  Strong and Electromagnetic
$$\alpha_s = \alpha_{EM} = 1$$

where m_p is the mass of a proton, m_e is the mass of an electron, k_B is Boltzmann constant, α is the fine-structure constant, $\hbar$ is Dirac constant.