II. The HyperGeometrical Universe Cosmology

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Abstract

This paper presents a new perception of the Universe (HyperGeometrical Universe Theory), a new concept of Time (dimensional time τ) and the addition of an extra dimension of time (Proper or Cosmological Time Φ).

Hubble Law is rederived from simple geometric arguments and corrected new derivation shows a way to precisely measure the age of the Universe using the **average** Hubble constant.

A new five-dimensional Universe topology (Hyperspherical Expanding Universe) is proposed. Correction to Relativity Velocity Addition Rules through cosmological distances is presented.

Cosmic Conundrum

What happened here, there and everywhere and can be seen today and forever happening in any direction if you look far enough?

Answer: The Big Bang (Q5). This and other answers will be found in the text.

Introduction

Throughout the ages mankind has looked into the skies and pondered these questions:

Q1.How was the Universe created [3]?

Q2.What lies outside the Universe?

Q3.What is the shape of the Universe

Q4.Why can't one see the past or the future?

Q5.Where did the Big Bang occur?

Q6.Why is the Universe so isotropic and homogeneous? This is a late line of questioning originated from the measurements of the cosmic microwave background. The cosmic microwave background is considered to be the result of Big Bang and it is puzzling isotropic and uniform.

Q7.What is the origin of the Microwave Cosmic Background?

Q8.Why isn't the Universe more like the result of any other three dimensional explosion?

Topology

The picture shown in Figure 1 represents a cross section of the proposed topology: The Hyperspherical Expanding Universe. The Universe is considered to be created as the result of a four-dimensional explosion. The evolution of a three-dimensional explosion is an expanding two-dimensional surface. The evolution of a four-dimensional explosion is an expanding three-dimensional hypersurface. All times are made dimensional by the multiplication by the speed of light.
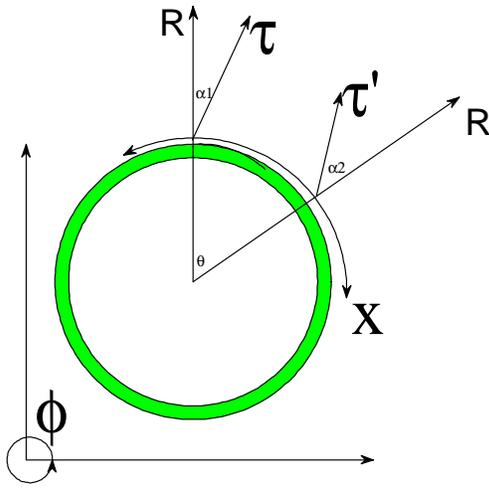

Figure 1. Shows the cross-section Xτ for the expanding Universe. The Universe length along X is represented by the band. X (or Y or Z) is displayed along the perimeter of the circle. Also shown in the diagram is Φ (Cosmological Time) and Radial Time R.

This figure displays the two time dimensions (R and Φ) and two time projections (τ and τ'). Each reference frame has its own time projection.

Definitions:

- Cosmological Time Φ represents an absolute time frame, as envisioned by Newton or Mach. It is a fifth dimensional in the HU model.

- Radial Time R, is also a dimensional time or can be seen as a fourth physical dimensional of propagation. It has a preferential direction (radial) and it defines a preferential time frame. Since one considers the Universe expansion velocity to be the speed of light, R keeps a simple relationship with Φ (identical module relationship).

- τ is any other propagation direction. This maps our local frame dimensional time and it is the source of the relativism in the Theory of Relativity. Different angles of propagation reflect different relative velocities.

- The angle between R and τ defines the local deformation of spacetime.

- The angle between τ' and τ defines the relative degree of local deformation of spacetime.

- There is a one-to-one relationship between the cosmological time and the propagation along radial vector (R(Φ)=cΦ) expressing the speed of light expansion of the hyperspherical Universe.

- The angle between the dimensional time τ and the radial direction R is the same as a relativistic twist (local deformation) of the spacetime with respect to an absolute time referential.

- Of course, $\hat{\Phi} = \hat{r} \times \hat{\tau}$, that is, τ is perpendicular to space (three-dimensional space) and the fifth-dimension Φ (Cosmological Time) is perpendicular to spacetime (four-dimensional spacetime).

HyperGeometrical Universe (HU) Model Origins

The Hypergeometrical Universe Model was created to answer these and other questions. The theory is based upon following arguments;

a) Relativistic Linear Momentum Equation

$$E = mc^2 = c\sqrt{p^2 + m_0{}^2 c^2} \qquad \text{or} \qquad P^2 = (mc)^2 = p^2 + m_0{}^2 c^2$$

What are these equations telling us about the topology of the Universe?

b) De Broglie Matter Waves should describe matter under any regimen!

Quantum Mechanics initial proposals were based on de Broglie Matter Waves (Bohr Atom). Pereira [1] developed a Grand Unification Theory based on de Broglie four-dimensional spacetime waves.

c) Isotropy and Homogeneity of the 3-D Universe

There is no direction in space where the extreme anisotropy originated in an explosion (Big Bang) can be detected.

d) Homogeneity of the Cosmic Microwave Background

"The thousandfold cosmic expansion since then has redshifted this ubiquitous, largely undisturbed radiation to a blackbody temperature of 2.725 K, with random anisotropies of only a few parts in 10^5 from point to point on the sky" [2].

e) Non-Constantness of the Hubble Constant.

Experimental values for the Hubble constant are scattered in a range as opposed to being a constant value for the whole Universe.

Relativistic Linear Momentum Equation

On Pereira [1], the Relativistic underlying reasoning for this theory was presented. Einstein proposed the following equation for the energy of a particle in motion as observerd by an inertial reference frame. This equation contains which are implications not yet well understood.

$$E = mc^2 = c\sqrt{p^2 + m_0{}^2 c^2} \qquad\qquad (1)$$

where m is the mass in the moving reference frame and m0 is the mass in the proper inertial reference frame. In the proper reference frame, the particle speed is zero.

This equation has implicit assumptions which can be brought into light by considering it a momentum conservation equation instead:

$$P^2 = (mc)^2 = p^2 + m_0^2 c^2 \qquad (2)$$

Where P is the momentum of a particle in motion (at the speed of light) traveling such that its $\tau_{particle}$ makes angle α with the static reference frame $\tau_{Observer}$.

Implicit in equation (2) is that the particle is actually traveling along a four-dimensional space (timed by a fifth time dimension) and has two linear momentum components:

    a) Three-dimensional momentum p

    b) Perpendicular momentum $m_0 c$ in the direction of dimensional Time τ. This means that the particle is traveling perpendicular to the 3-D space at the speed of light!

The addition of these two linear momenta is equivalent to a particle that travels at the speed of light in along a hypotenuse in a five dimensional space with an inertial mass m. This is exactly what the particle is doing while moving along on the hypersurface of an expanding hyperspherical Universe.

This equation supports a five-dimensional space with three time dimensions (Cosmological Time Φ, Radial Time R and dimensional time τ) and three spatial dimensions (XYZ) as depicted in Figure 1.

de Broglie Matter Waves

Pereira[1] demonstrated that a five-dimensional Universe provides the framework for a simple Grand Unification Theory based upon interference of four-dimensional de Broglie Matter waves overlaid in an expanding Hyperspherical Universe.

Homogeneity of the Cosmic Microwave Background and the Lack of Cosmic Energy and Material Anisotropy

Another inconsistency clamoring to be solved is the inexistence of a highly anisotropic Universe. On the contrary, the Universe is very homogeneous, being the microwave cosmic background rippled by only a few parts in a hundred thousand.

This is not consistent with the existence of a single location for the Big Bang. A four-dimensional space makes no allowance for a delocalized Big Bang, a five-dimensional space does!

Non-Constantness of the Hubble Constant

HU theory explains why the Hubble constant is not constant. A three-dimensional explosion would create a balloon-like Universe where receding speeds would be perfectly

defined by an angle times the speed of ejection. The entire Universe would present two motions, one radial and a side-drift. The drift would be modeled by the Hubble equation. In this Universe, the Hubble constant would be a constant, matter and energy would be anisotropic distributed and the cosmic microwave background would come from a single direction. These results are in conflict with the present knowledge of the Universe. A four-dimensional explosion would create an expanding hyperspherical Universe. At time zero, the Universe cross-sections (see Figure 1) would be just small circumferences. The Big Bang would put in place the motion of the hypersphere and the continuous expansion of the cross-sectional circumferences. This means that the decaying of the initial Big Bang particle would take place throughout each and every point of the circumferences, thus the Big Bang would occur in each and every point of the Universe.

Conclusions:

All conclusions presented here are straightforward and can be easily understood with the aid of Figure 1.

Time Conclusions

1. There are not one, two but three distinct time directions. The Cosmological Time and the Radial Time are synchronous, that is the radial expansion of the Hyperspherical Universe happens at the speed of light. These two times are **<u>Absolute</u>**. Although absolute, one cannot measure time using them, unless one can observe directly the Hyperspherical Expansion of The Universe.

2. The cross-reference-frame observed time τ and τ' are **<u>Relative</u>**.

Hence time can be both **<u>Absolute</u>** and **<u>Relative</u>** and both Einstein and Newton were right.

Astronomical Conclusions:

3. The entire Universe is contained in a very thin three-dimensional hypersurface of a four-dimensional hypersphere of radius c*[Age of The Universe].

4. The thickness of this hypersurface is a de Broglie wavelength, the uncertainty in the dimensional time direction.

5. The average radius of curvature of this hypersurface is exactly the speed of light times the age of the Universe, or R=15 billion light-years or so. Of course, the standard deviation of this radius is a de Broglie wavelength and it depends upon the mass associated with that specific region of space. Oddly, the uncertainty in time is the smallest for Black Holes. In a future paper, we will address the events associated with Black Holes and other forms of polarized exotic matter.

6. The visible Universe volume is given by: $VisibleUniverseVolume = \dfrac{4\pi R^3}{3}$.

7. The whole (Visible plus Invisible) Universe should have a volume of

$$UniverseVolume = \frac{4\pi(\pi R)^3}{3} \ .$$

8. Beyond the visible Universe lies the Never-to-be-Seen-Universe, whose linear dimension is actually $(2\pi\text{-}2)$ times the dimensional time radius of the hypersphere. $3\pi/2R$ of the Universe linear dimension can never be reached

9. The actual radius of the Universe is πR or around 47 billion light-years.

10. Of course, the four-dimensional light speed expanding hypersurface topology also explains why the Big Bang radiation comes from all directions and why one cannot ever locate a simple point where the Big Bang occurred. The Big Bang will always seem to have occurred in any direction if one looks far enough (the dimensional age of the Universe) and that is the result of four-dimensional explosion dynamics.

11. The other topology derived conclusion is that if one could "see and measure velocity using Cosmological Time" farther than the dimensional time radius of the Universe, galaxies would be traveling at speeds faster than the speed of light with respect to us. This wouldn't be the case if we measure any velocity using cross-reference time. Under those circumstances the maximum velocity is c.

12. The fact that it is impossible to "see" any farther than the dimensional radius of the Universe means that the postulate of Relativity remains semi-solid. If one travels far enough but not as far as the age of dimensional radius of the Universe, one still could travel at speeds faster than the speed of light.

13. The absolute highest receding speed of this Universe is πc, which is the real speed bump in the whole Universe. Absolute speeds are measure with respect to the Cosmological Time Φ.

14. Since the receding speed of the Big Bang is equal to the speed of light, all its energy is Doppler shifted by the time they arrive at us, thus one cannot ever observe the Big Bang with a telescope. On the other hand, one can probe the initial dynamics by looking as far as one can with a large telescope.

15. The Cosmic Microwave Background is likely to be Doppler Shifted Gamma Radiation and not Blackbody Equilibrium Radiation.

16. Another corollary of this theory is the Hubble conclusion about an expanding hyperspherical Universe. The speed of light divided by the **average** numerical value for the Hubble constant is the inverse of the Age of the Universe (e.g. 15.0 Billion years, 50 Km/s per megaparsec with one megaparsec = 3 million light years). The averaging is necessary since if one looks at any direction, there will be debris from the Big Bang (Galaxies) of different sizes traveling towards and from your direction.

17. The topology offers the revolutionary perception that while we see ourselves at rest we are actually traveling at the speed of light in a direction perpendicular to all the three dimensions we can perceive in our daily life. General Relativity and present

Cosmology has no qualms associating a Black Hole with a disturbance of spacetime continuum. Since we could easily fall into a Black Hole, it is not surprising that we should be modeled as a disturbance of the spacetime continuum in a similar manner. Like any disturbance, there is a natural propagation velocity, in our case that velocity is c (the speed of light).

18. One can easily see that the Big Bang occurred when the Universe was an infinitesimally small circle across each one of the three dimensions, thus it spanned the whole Universe. It occurred on all places at the same time. This is the basis for the non-locality of the Big Bang in a three-dimensional Universe projection. This means that in our Universe, the Big Bang occurred exactly where we are no matter where we are. The heat, horrendous explosion and debris has long since left this region and now one only can see the beginning of the Universe if one looks very far away to see the debris that traveled the age of the Universe and are only now reaching us. This is a quite surprising and elegant conclusion.

19. Due to the topology of a four-dimensional Big Bang, the center of the Universe is a location in radial time and not in space. This will become clearer when the Cosmogenesis model is presented.

20. Unlike motions along other directions of the four dimensional space, travel along the radial time occurs only at the speed of light.

21. The visible Universe corresponds to a hyper-cap in this hypersphere. The hyper-cap radius is also the age of the Universe, which is also the average radius of curvature of the hypersphere. Thus the Universe is not only finite but also curved: a perfect circle.

22. Despite of that one cannot travel around it (due to its expansion at the speed of light) and due to the limit imposed on the highest traveling speed in this Universe. Finite, circular but impossible to traverse.

23. In addition, the hypersphere model makes any point in the Universe equivalent to another; in the same way that no point on the surface of an expanding balloon is closer to the origin of times (its center or the point in space defined by the balloon when it was very small).

24. The fact that we cannot see the past or travel there is because it does not exist any longer, due to the extremely thin character of the hyperspherical Universe (Q4). It is only a de Broglie wavelength thick. Needless to say, one cannot either travel to the future because it doesn't exist yet. We only can reach the future when it is the present, since we are traveling there even as we speak.

25. Beyond the Big Bang lies more of the same (Q2) (Universe), albeit invisible Universe. The furthest visible part of the Universe is the Big Bang, that doesn't mean that one could traveling faster than the speed of light go there and see it first hand. It only means that if we travel at the speed of light in any direction, the cosmic microwave background will Doppler shift into gamma rays (a possible tremendous inconvenience for light speed travelers) and one will be able to actually see the

beginning. From Figure 1, it is clear that the hypersphere is uniform and that traveling in any direction wouldn't bring us into the past. The hypersphere travels inexorably into the future.

26. It becomes clear that the Hubble expansion theory has to be modified to accommodate a four-dimensional Big Bang. The change is that in a four-dimensional explosion the Big Bang occurred in each and every point of the initial circumference, that is, the Big Bang occurred in each and every point of the Universe (Q5) at the same time. From each and every point, energy and matter were ejected by tremendous forces. This means, that at any given point of the Universe there is a three dimensional isotropic expansion (Q6) and thus the average Hubble constant is equal to the inverse of the dimensional age of the Universe times the speed of light. In a three-dimensional Big Bang, matter would expand radially from a single point, thus the Universe would be highly anisotropic and the Hubble constant would be a constant (Q8).

27. Finally, the relativistic effects and inertia are due to local distortions of the curvature of this hyperspherical surface. The highest distortion one can create is to travel at the speed of light. That corresponds to having one's dimensional time vector τ at 45 degrees with the three-dimensional space. Different regions of the hypersurface have different tangents with respect to an originating point, thus flow of observed time will depend upon how fast and how far you travel. One does have receding velocities that are larger than the speed of light, indicating the Relativity is a local approximation of Universe dynamics.

28. Appendix A showcase modifications to Relativity that allows for the higher than the speed of light receding speeds expected in a hyperspherical expanding Universe. It also shows the correct way to add receding speeds over Cosmological distances.

Grand Unification Conclusions

29. The meaning of physical existence is being phase-matched along the dimensional time direction.

30. Appendix A shows that one can see all the way up to the Big Bang (or thereabouts), but one can only reach a Cosmological angle of $\pi/4$ due to the Universe expansion.

31. Quarks are modeled as positive and negative axes' length of the ellipsoid of revolution. A negative axis length means that the four-dimensional wave generated along that axis direction has a negative phase (180 degrees phase shift). The directionality of waves will only play a role when one discusses polarized matter. From this description it becomes evident that anti-matter should produce anti-gravity. This is supported by the grand unification equations [1]. It also becomes evident the possibility of fully anti-matter galaxies in the Universe and why they do not collide with matter galaxies.

32. The light speed, fast expanding hypersphere model of the Universe allows for the existence of an infinite number of other hyperspherical expanding Universes, separated by dimensional time intervals. The source of "matter and energy" will be explained in the Cosmogenesis paper of this series. Although there is an allowance, it will be described that the Big Bang occurred simultaneously with Dimensional Transitions. This seems to preclude the coexistence of Hyperspherical Universes.

33. There is no need to use anti-gravity forces, Dark Energy to explain the expansion of the Universe. Simple geometric reasoning is enough. That doesn't mean that anti-gravity force will not be present in our model of the Universe. <u>Antimatter should present antigravity properties[1] and exist in equal abundance in antimatter Galaxies.</u>.

34. The fate of the Universe is continuous expansion. It will become clear how the Universe recycles itself and what is the meaning of recycling in the Cosmogenesis paper.

Appendix A

HU Corrections to Relativity

Let's consider velocity addition as a function of cosmological angle θ.
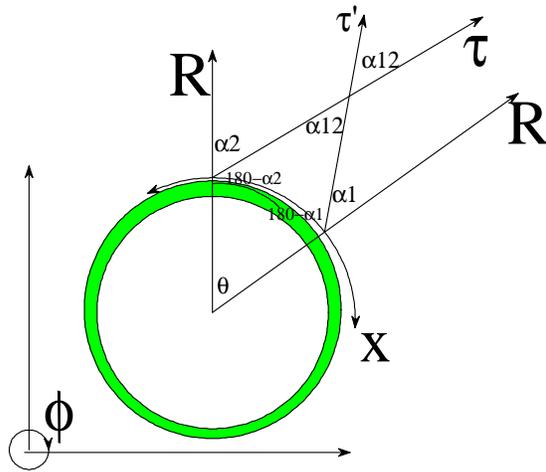

Figure 2. Hyperspherical Universe Model displaying two reference frames.

The two velocities are given by their angles with the Cosmological Radial direction. From simple trigonometry, one obtains:

$$\alpha_{12} + (180^0 - \alpha_1) + (180^0 - \alpha_2) + \theta = 360^0 \ \text{Or} \ \alpha_{12} = \alpha_1 + \alpha_2 - \theta$$

This means that when $\theta = \alpha_1 + \alpha_2$ the two parties will never meet. There are two special case of interest:

- The two bodies are traveling at the speed of light ($\alpha_1 = \alpha_2 = \pi/4$). Under those conditions θ=π/2. This means that two traveling parties departing up to a cosmological angle θ=π/2, can meet half-way if they travel at the speed of light.

- The other case is when one is deciding to explore some of the Universe and travel at the speed of light ($\alpha_1 = \pi/4$, $\alpha_2 = 0$). This means that one can only explore one quarter of the Universe length in any direction.

The correct relativistic velocity addition rule can be written as:

$$\tan(\alpha_{12}) = \frac{v_{12}}{c} = \tan(\alpha_1 + \alpha_2 - \theta) = \frac{\dfrac{\tan(\alpha_1) + \tan(\alpha_2)}{1 + \tan(\alpha_1)\tan(\alpha_2)} - \tan(\theta)}{1 - \dfrac{\tan(\alpha_1) + \tan(\alpha_2)}{1 + \tan(\alpha_1)\tan(\alpha_2)}\tan(\theta)} \tag{A.1}$$

Or

$$v_{12} = \frac{v_1 + v_2 - c\tan(\theta)(1 + \dfrac{v_1 v_2}{c^2})}{1 + \dfrac{v_1 v_2}{c^2} - \dfrac{\tan(\theta)}{c}(v_1 + v_2)} \tag{A.2}$$

<u>Relativity fails for cosmological distances</u>. It is worth emphasizing that for tan(θ)=1 (θ=45°), independently upon the local velocities v_1 and v_2, the perceived velocity v_{12} is always -c.

$$v_{12} = \frac{v_1 + v_2 - c(1 + \dfrac{v_1 v_2}{c^2})}{1 + \dfrac{v_1 v_2}{c^2} - \dfrac{1}{c}(v_1 + v_2)} = -c \tag{A.3}$$

Thus for θ=45°, anything at that cosmological angle will be rushing away at the speed of light.

Beyond that cosmological angle, relative time references and relative velocities are meaningless since there can not ever be communication or energy exchange between these two sites. There is a subtle difference between communication and travel and seeing the cosmological past, which has to do with the nature of light.

It is important to distinguish that the above derivation has to do with places one can travel or reach in terms of cosmological angles and not places one can see. One can see all the way to the beginning of times (with Doppler Shifted Vision – by upconverting the cosmic microwave background through fast traveling or other photonic means). The beginning of the Universe will always stare us in the eye, sitting at one radian or at the Beginning of Time. Gamma Radiation Doppler Shifted from the Big Bang is likely to be the pervasive Cosmic Microwave Background.

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