Hypergeometrical Universe

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This paper presents a simple and purely geometrical Grand Unification Theory. Quantum Gravity, Electrostatic and Magnetic interactions are shown in a unified framework. Biot-Savart Law is derived from first principles. Unification symmetry is defined for all the existing forces. A 4D Shock-Wave Hyperspherical topology is proposed for the Universe together with a Quantum Lagrangian Principle resulting in a quantized stepwise expansion for the whole Universe along a radial direction in a 4D spatial manifold. The hypergeometrical standard model for matter is presented.

1 Introduction

Grand Unification Theories are the subject of intense research. Among current theories, Superstring, M-Theory, Kaluza-Klein based 5D Gauge Theories have shown diverse degrees of success. All theories try to keep the current conceptual framework of science. Kaluza-Klein melded both Electromagnetism and Einstein Gravitational equations in a 5D metric.

Here is presented a theory that departs radically from other theories and tries to bridge the conceptual gap as opposed to explore the formalism gap. Most research is concerned on how to express some view of Nature in a mathematically elegant formalism while keeping what we already know. It has been said that for a theory to be correct, it has to be beautiful.

This work concentrates on what to say, the conceptual framework of Nature instead. All the constructs of science, matter, charge, and energy are dropped in favor of just dilator positions and dilaton fields, which are metric modulators and traveling modulations, respectively. There is no concept of charges or mass. Mass is modeled a quantity proportional to the 4D displacement volume at **precise phases de Broglie cycles**. Charge sign is modeled by dilaton phase (sign) on those specific phases. This mapping is not necessary for calibration; there are no calibration parameters in this theory. The mapping is needed to show that the geometrical framework replicates current scientific knowledge.

We propose that dilators are the basic model of matter. They are coherences between two states in a rotating four-dimensional double well potential. A single coherence between two 4D-space deformation states or fundamental dilator is considered to account of all the constituents of non-exotic matter (elements, neutrons, electrons and protons and their antimatter counterparties). This coherence is between two deformation states with 4D volumes corresponding to the electron and proton, or electron-proton coherence. **Here the proton and the electron are considered to be the same particle or the fundamental dilator, just two faces of the same coin.**

The equation that describes these states is not the subject of this work. In section 2.9, a detailed description of the fundamental dilator is given, as well as the origin of the spin quantization.

Dilaton are the 5D spacetime waves, traveling metric modulations, created by the alternating (back and forth) motion of the fundamental dilator from one state of the double potential well to the other. Since these two states have different displacement volumes, spacetime waves are created. Displacement volumes are the missing (extra) volume due to spacetime contraction (dilation). Let's say that one has two points separated by a distance L in a 4D space with a dilator in the middle. The distance between those two points will change depending upon the phase of dilaton. If one considers this maximum distance change along the four dimensions for each of the two states, would be able to determine the dilator volume on each state and thus fully characterize it.

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In addition to tunneling back and forth, the proton-electron dilator is considered to be tumbling (spinning) as it propagates radially (along the radial expansion direction) and that poses a constraint on the spinning frequency. Spin half particles are modeled as having a spinning frequency equal to half the electron-proton dilator tunneling frequency. Similarly higher spin particle coherences, e.g. spin N, are modeled as having a spinning frequency equal to N times the electron-proton dilator tunneling frequency.

Whenever the word dilator is mentioned within this paper, it will refer to the fundamental dilator or fundamental coherence, although there are other coherences in nature and similarly associated particle pairs.

A 3D projection of this volume corresponds to the perceived 3D mass, a familiar concept.

A logical framework is proposed on the Hypergeometrical Universe[1] section. This model conceptualize the 3D universe manifold as being a 3D shock wave universe traveling at the speed of light in a direction perpendicular to itself, along the radial direction.

Absolute time, absolute 4D Cartesian space manifold are proposed without loss of time and space relativism. Thus there are both preferential direction in space and preferential time, but they are both non-observables.

On the cosmological coherence section, the consequences of the topology of the hypergeometrical universe and the homogeneity proposed in the Hypergeometrical Standard Model is shown to result in a cosmological coherence, that is, the whole 3D universe expands radially at light speed and in de Broglie (Compton) steps.

When cosmological coherence is mentioned it is within the framework of absolute time and absolute 4D space.

A new Quantum Lagrangian Principle (QLP) is created to describe the interaction of dilators and dilatons. Quantum gravity, electrostatics and magnetism laws are derived subsequently as the result of simple constructive interference of five-dimensional spacetime waves[2] overlaid on an expanding hyperspherical universe described in section 3. In the electrostatics and magnetism derivation, a one atomic mass unit (a.m.u) electron or fat electron is used. This means that the dilatons being 5D spacetime waves driven by coherent metric modulations are sensitive to both sides of the dilator coherence.

Since 3D mass – the mass of an electron or proton from the 3D universe manifold perspective - is sensitive only to one side of the dilator coherence, the side of the dilator in phase with the 3D shock wave universe, a pseudo time-quantization is proposed in section 2.9.

Appendix A contains a brief description of the Hypergeometrical Standard Model. It shows that hyperons and the elements are modeled as longer coherences of tumbling 4D deformations. Nuclear energy is proposed to be stored on sub-coherence local twisting of the fabric of space. A more detailed description of the model will be presented elsewhere.

A grand unification theory is a far-reaching theory and touches many areas of knowledge. Arguments supporting this kind of theory have by definition to be equally scattered. Many arguments will be presented with little discussion when they are immediate conclusions of the topology or simple logic.

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2 Hyperspherical Universe

2.1 Quantum Lagrangian Principle

A new Quantum Lagrangian Principle (QLP) is defined in terms of dilator and dilaton fields. It proposes that the dilator is always in phase with the surrounding dilatons at multiples of 2π wavelength. This simply means that a dilator, trying to change the metric in a specific region of 4D space, will always do that in phase with all the other dilators. The fundamental dilaton wavelength will be called de Broglie wavelength and will be shown in the section 2.9 to correspond to the Compton wavelength, since motion along the radial direction is at lightspeed, of a one atomic mass unit particle.

2.2 Topology

The picture shown in Figure 1 represents a cross section of the hyperspherical light speed expanding universe. The universe is considered to be created by an explosion, but not by a three-dimensional explosion. Instead, it is considered 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 on quantized de Broglie steps. The steps have length equal to the Compton wavelength associated with the fundamental dilator (one atomic mass unit).** All times are made dimensional by the multiplication by the speed of light.

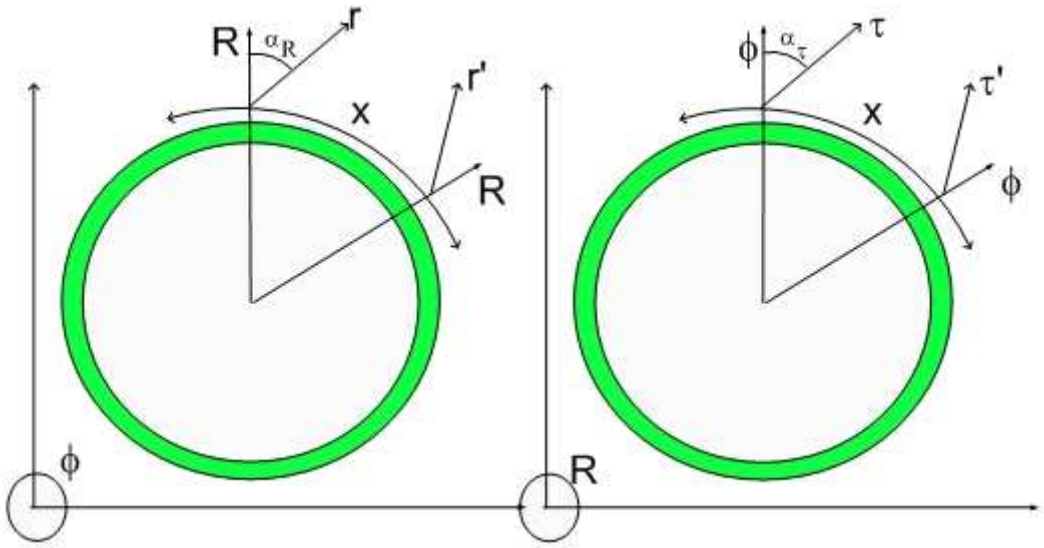

Figure 1. Shows the cross-section $X\tau$ and XR for the expanding universe. The universe length along X is represented by the band. X (or Y or Z) is displayed along the perimeter of the circle. Also shown in the diagram is Φ (cosmological time) and radial time projection R.

Definitions:

- Cosmological time Φ represents an absolute time frame, as envisioned by Newton and Mach - it is a fifth dimension in the hypergeometrical universe model.

- The radial direction is a preferential direction in 4D space. It is the radial expansion direction. This direction doubles as a direction on 4D Space and a projection of the cosmological time. Since they are related by the expansion speed (light speed), one can think about the radial direction as the radial time – an absolute time projection.
- Similarly, τ is any other propagation direction and also a projection of proper time, here called dimensional time. For small velocities with respect to the fabric of space (see description below), the dimensional time approximately matches the 4D direction of propagation (artan (v/c)~arctanh(v/c)~v/c). This maps our local frame proper time to a 4D direction of propagation and it is the source of the relativism in the theory of relativity. Different angles of propagation reflect different relative velocities. Notice that although this argument made use of a preferential 4D direction, it could be done using any possible referential frame. Within the 3D space, one can only observe the relative angle and relative velocity.
- This mapping done because of the consideration that a Lorentz transformation can be thought as a rotation around the directions perpendicular to proper time and velocity by an imaginary angle of arctanh (v/c). On a 4D spacetime, when one considers a proper frame of reference, one only travels in time. The addition of a fourth spatial dimension means also that when one is in one's proper 3D frame of reference one is also propagating along either the directions R/Φ or r/τ.
- R keeps a simple relationship with the dimensionalized cosmological time Φ (identical module relationship).
- The fabric of space (FS) is just the region of 4D space – a traveling boundary- where the 3D hypersurface (shock wave universe) stands at any given time. It is different from the rest of the 4D space because it contains imprinted in local deformations, all particles in the universe.
- Fabric of space is used in two manners: a) as the locally non-twisted 4D space – pointing to this traveling boundary-, where local proper time projection τ and direction of 4D propagation points in the radial direction Φ/ R and b) the subject of deformation.
- Under these conditions one can define a referential frame that is standing still with respect to the FS while traveling at the speed of light outwards radially. This is a preferred referential frame. Two preferred referential frames far apart in 3D space will recede from each other at the Hubble's speed (see section 2.5).
- After the shock wave universe passes through, the 4D space returns to it relaxed condition.
- There are two kinds of deformations in 4D space: compression and torsion. The compression is what happens in dilators or particles. They represent coherence between two compression deformation states.
- Torsional states are related to absolute state of motion of neutral matter and are defined by the local tilt of the perpendicular to the FS region inhabited by it. The FS can be under torsional forces in the region near dilators. The region where a dilator exists will persist under stress (tilted) as the dilator moves towards a region where that stress can be relaxed.
- Far from matter, there should be only residual torsional deformation due to the evanescing dilatons. On the other hand, the region of space where a "zero spin particle" or neutral matter exists, the local environment is permanently deformed through

interactions with other bodies' dilatons. Deformation will last until the all the interacting bodies reach regions where their relative velocity matches the Hubble velocity of that part of the Fabric of Space.

- The angle between R (Φ) and r (τ) defines the local FS deformation.
- The angle between τ' (r') and τ (r) defines the relative degree of local FS deformation.
- "Volumetric" and "superficial" dilatons are 5D and 4D spacetime waves define in analogy to volumetric and superficial sound waves. Instead of having pressure or density modulations as in sound waves, one has metric (or 4D space) modulations.
- Since the hypersurface is our three-dimensional universe, a "superficial" dilaton is a spacetime disturbance that propagates along the FS. Associated zero spin dilators will propagate always in perpendicular to the FS, although they might move sidewise between de Broglie expansion steps.
- A "volumetric" spacetime dilaton is free to redirect its k-vector on any direction. Associated non-zero spin dilators will be able to freely change their propagation direction in addition to the sidewise motions at each de Broglie expansion step.
- Dilatons and dilators are used interchangeably in certain situations since the QLP requires the dilatons to always be in phase (surf) the surrounding dilaton field.

Figure 1 displays one time dimension (Φ) and three time projections (R, τ and τ'). Each reference frame has its own proper time projection. This figure also shows that the four-dimensional spacetime is curved, being the radius of curvature given by the dimensional age of the universe. This simple figure eliminates the need for cosmological constant questions, considerations about gravitational collapse or anti-gravitational acceleration of the expansion of the three-dimensional universe, since the universe is proposed to be four-dimensional plus a cosmological time Φ. In this model, the shock wave hyperspherical universe is clearly finite, circular (radius of curvature equal to the dimensional age of the universe, that is, the speed of light times the age of the universe). It is also impossible to traverse, since it is expanding at the speed of light. **The Cosmic Microwave Background is assigned to a Doppler shifted view of the initial Gamma Radiation Burst**[3].

2.3 Origins of the Hyperspherical Expansion

The clues for the creation of this models lies on relativity and quantum mechanics. Relativity states that the energy of a particle with rest mass m_0 and momentum p is given by:

$$E = mc^2 = c\sqrt{p^2 + m_0{}^2 c^2} \tag{2.1}$$

where m is the mass in motion. This equation has implicit assumptions which can be brought into light by considering it a momentum conservation equation instead:

$$P^2 = (mc)^2 = p^2 + m_0{}^2 c^2 \tag{2.2}$$

Where P is the four-momentum of the 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 (2.2) 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_0c in the direction of radial time.

In addition, the particle travels at the speed of light in along a hypotenuse with an inertial mass m. Now it starts to become clear that the motion of the particle is actually in a five dimensional space (four physical dimensions and a time) and at the speed of light, being the three dimension motion just a drift. The trigonometric functions associated with a relativistic Lorentz transformation are given in terms of velocity by:

$$\cosh(\alpha) = = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{2.3}$$

$$\sinh(\alpha) = = \frac{\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{2.4}$$

$$\tanh(\alpha) = \beta = \frac{v}{c} \tag{2.5}$$

Manipulating equation (2.2) and using $m=m_0\cosh(\alpha)$ one obtains:

$$(mc)^2 = (mv)^2 + m_0{}^2c^2 \tag{2.6}$$

$$(m_0\cosh(\alpha)c)^2 = (m_0 v\cosh(\alpha))^2 + m_0{}^2c^2 \tag{2.7}$$

$$(m_0\cosh(\alpha)c)^2 = (m_0\sinh(\alpha)c)^2 + m_0{}^2c^2 \tag{2.8}$$

$$\left(\frac{1}{\lambda_\tau}\right)^2 = \left(\frac{1}{\lambda_{x\,\mathrm{Prime}}}\right)^2 - \left(\frac{1}{\lambda_{\tau\,\mathrm{Prime}}}\right)^2 \tag{2.9}$$

With

$\frac{1}{\lambda_\tau} = \frac{m_0c}{h}$ de Broglie wavelength for the particle on its own reference frame, traveling at the speed of light in the proper time projection τ direction.

Projection on the τprime direction.

$$\frac{1}{\lambda_{\tau\,\mathrm{Prime}}} = \frac{1}{\lambda_\tau}\cosh(\alpha)$$

Projection on the xprime direction.

$$\frac{1}{\lambda_{x\,\mathrm{Prime}}} = \frac{1}{\lambda_\tau}\sinh(\alpha)$$

Equation (2.9) is the basic equation for the quantization of relativity. It describes the motion of a particle as the interaction of two waves along proper time projection and three-dimensional space. The $\lambda_{\tau\,\mathrm{Prime}}$, that is, the projection on the τ' axis of the wave propagating along the τ axis (resting reference frame) is given by:

$$\frac{\lambda_\tau}{\lambda_{\tau\,\mathrm{Prime}}} = \cosh(\alpha) \tag{2.10}$$

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$$\frac{\lambda_\tau}{\lambda_{x\,\mathrm{Prime}}} = \sinh(\alpha) \tag{2.11}$$

This means that the projected de Broglie time-traveling wavelength is zero when the relative velocity reaches the speed of light. Zero wavelengths means infinite energy is required to twist spacetime further. The rate of spacetime twisting with respect to proper time relates to the power needed to accelerate the particle to a given speed. From equation (2.5), acceleration in the moving reference frame can be calculated to be:

$$Acceleration_{\mathrm{Prime}} = c^2 \frac{d\tanh(\alpha)}{d\tau_{\mathrm{Prime}}} \tag{2.12}$$

In the particle reference frame the acceleration has to be given by Newton's second law

$$Force = M_0 Acceleration_{\mathrm{Prime}} = M_0 c^2 \frac{d\tanh(\alpha)}{d\tau_{\mathrm{Prime}}} \tag{2.13}$$

This means that any force locally twists spacetime, and not only gravitation as it is considered in general relativity. It also shows that as the relative speed between the two reference frames increases towards the speed of light, the required force to accelerate the particle approaches infinite. The same reasoning can be done for the concomitant rotation perpendicular to RX, resulting in the replacing the minus sign by a plus sign on equation (2.9) and the recasting equations (2.10) and (2.11) in terms of trigonometric functions as opposed to hyperbolic functions. Rotations around τX or RX result in a real angle α= arctan(v/c).

Figure 2 below displays the particle as a de Broglie wave oscillating as a function of cosmological time Φ, propagating along R. This is a proper reference frame plot, that is, the particle is at rest at the origin with respect to the fabric of space and only travels along the radial time direction R.

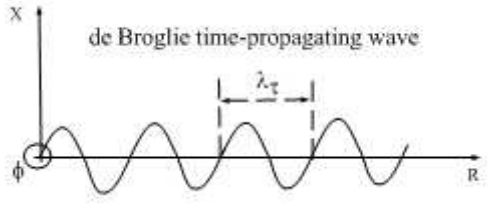

Figure 2. This model shows a de Broglie oscillation as a function of Cosmological Time Φ using the proxy of time R.

The diagram below represents the same observation from a moving frame of reference (relative velocity c times tan(α)):

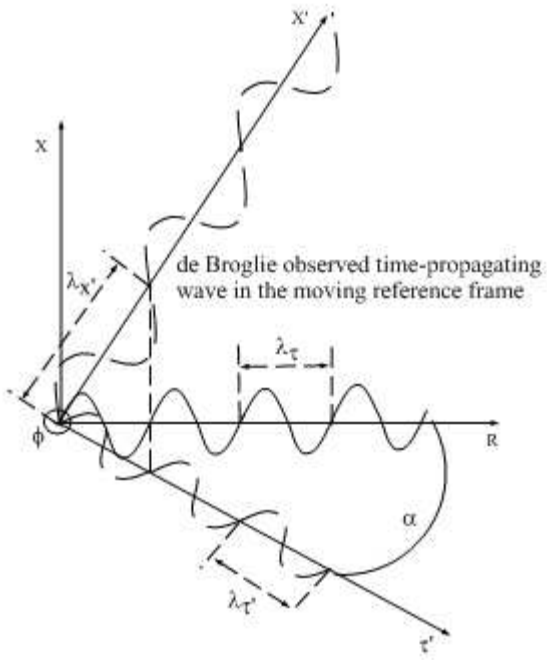

Figure 3. Projection of de Broglie Wave in the moving frame of reference.

Energy Conservation of de Broglie Waves:

The total kinetic energy, calculated in terms of de Broglie momenta, is equal to the Relativistic Total Energy value of a free particle. The total energy is M_0c^2 in the proper reference frame and equal to:

$$E = \frac{1}{M_0}\left[\left(\frac{h}{\lambda_{x\,\mathrm{Prime}}}\right)^2 - \left(\frac{h}{\lambda_{t\,\mathrm{Prime}}}\right)^2\right] = \frac{h^2}{M_0}\left[\left(\frac{\cosh(\alpha)}{\lambda_t}\right)^2 - \left(\frac{\sinh(\alpha)}{\lambda_t}\right)^2\right] = \frac{h^2}{M_0\lambda^2\tau} = M_0c^2 \qquad (2.14)$$

in the moving referential frame.

Phase Matched de Broglie Wave Interpretation of a Particle

Let consider a particle as a de Broglie wave. In its own referential, it just propagates in the direction of radial time R, as in figure 2. On a moving reference frame, shown in figure 3, the de Broglie wave is decomposed in two:

- One with wavelength $\frac{1}{\lambda_{x\,\mathrm{Prime}}} = \frac{\cosh(\alpha)}{\lambda_\tau}$ propagating along x
- A second with wavelength $\frac{1}{\lambda_{\tau\,\mathrm{Prime}}} = \frac{\sinh(\alpha)}{\lambda_\tau}$ propagating along τ.

Their nonlinear interaction results in:

$$\psi_1(x,\tau) = \cos\left(\frac{2\pi}{\lambda_e}x\cosh(\alpha)\right)\cosh\left(\frac{2\pi}{\lambda_e}\tau\sinh(\alpha)\right) \qquad (2.15)$$

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$$\psi_1(x,\tau)=\frac{1}{2}\cosh(\frac{2\pi}{\lambda_e}(x\cosh(\alpha)-\tau\sinh(\alpha)))+\frac{1}{2}\cos(\frac{2\pi}{\lambda_e}(x\cosh(\alpha)+\tau\sinh(\alpha))) \quad (2.16)$$

or two waves propagating in the direction of α and –α with wavelength equal to $\frac{\lambda_e}{\cosh(\alpha)}$. Thus a particle can be described as a phase matched wave propagating along its dimensional time direction as the hyperspherical universe expands as a function of cosmological time.

2.4 The Meaning of Inertia

From equation (2.12) it is clear that inertia is a measure of the spring constant of spacetime, that is, how difficult it is to twist spacetime. Any change in the state of motion also changes the direction as referred to the absolute referential frame RΦ, which means that inertia is also a measure of how difficult it is to locally twist the fabric of space.

Notice that Newton's first equation (equation 2.13) can be recast as an equation stating that the strain on the fabric of space is the same on both projections shown in figure 1.

$\frac{d\tanh(\alpha_\tau)}{d\tau}=\frac{d\tan(\alpha_R)}{dr}$ since $\tanh(\alpha_\tau)=\tan(\alpha_R)=\frac{v}{c}$ and r and τ are numerically identical.

To obtain the force (stress) needed to create such a strain, one needs to multiply the strain by the area subject to it. In the 4D hyperspherical paradigm, this means that the mass is proportional to the 3D projection of the 4D displacement volume associated with the objects (particles).

This identity is used thoroughly during the grand unification calculations on section 3.

2.5 Why do things move?

The relaxation of a fabric of space deformation is considered within this theory to be the cause of inertial motion. Two objects would act upon each other and then distance themselves until their interaction is vanishingly small. Under those conditions their distance would grow until they reach their Hubble equilibrium position, that is:

$$v = C_{Hubble} * L_{HubbleEqui\ librium} \quad (2.17)$$

$$L_{HubbleEquilibrium}=\frac{v*4DRadiusOfTheUniverse}{c} \quad (2.18)$$

Where it is clear that the Hubble constant is given by:

$$C_{Hubble}=\frac{c}{4DRadiusOfTheUniverse} \quad (2.19)$$

The 4D radius of the universe is shown in Figure 1, and it is equal to the age of the universe times c. At that point, 4D space would be relaxed and their distance would grow governed by the universe expansion. Even though matter would be standing still with respect to the FS, their relative motion would continue at the Hubble speed forever. The fraction of the universe that is relaxed at any given time and direction can be measured from the distribution of Hubble constants. The narrower the distribution of Hubble constants from a given region of the Universe, the more relaxed that region is. **Needless to say, this is the underlying reason for Newton's first law.** The proposed topology implies that the Big Bang occurred on all points of the shock wave universe (or the currently known 3D Universe) at the same time. Since matter is considered to have rushed away from each and every point of the 3D universe in a spherically

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symmetric manner, the Hubble constant has to be a constant for the average. Other cosmological implications will be discussed in a companion paper.

Equation (2.16) might seem obvious but it is not. There are questions about why the Hubble constant is not constant. In this theory it is clear that the Hubble constant relates to the average velocity in a given region of space and thus it should not be a constant applicable to each and every observation.

2.6 Why is the Speed of Light the Limiting Speed

In this model, in a de Broglie universe expansion step, the furthest a dilator can move is one de Broglie wavelength sidewise, that is, along the spatial direction (see Figure 1). That would result in a 45 degrees angle with respect with R.
The proposition of this theory is that this is the real reason for Lorentz transformations asymptotic behavior and that inertia is really a measure of the difficulty to bend local 4D space. In section 2.3 it became clear that they are the same rotation, driven by the change in velocity.
From Hubble considerations and from examining Figure 1, it is clear that the maximum absolute speed is π*c, but cannot be measured because one can never see or reach anything beyond one radian in the shock wave universe.

2.7 Hypergeometrical Standard Model

A new model for matter is proposed. In this initial model, the elements, protons, electrons and neutrons and their antimatter counterparties are recast as being derived from a single particle. This particle is expressed in geometrical terms as being a coherence between two 4D deformation stationary states from a rotating 4D double potential well. This coherence is called a dilator. As the dilator oscillates between sides of the potential well, it creates a traveling modulation of the metric or 5D spacetime waves or dilatons. Spin is modeled not as an intrinsic degree of freedom, but as an extrinsic tumbling or rotation of the dilator. **Since the dilaton frequency is defined just by the gap between the fundamental dilator states, it frequency does not depends upon the mass of the dilator**. Dilatons travel through the 4D space. 3D projections are known as de Broglie matter waves. This is an important concept since a corollary is that a monochromatic (same velocity) flow of electrons will produce a coherence dilaton field, superimposed on the dilaton random black body background. This will be used to explain the double slit experiment in the Conclusions section. Planck's constant is the connection between the 3D dilaton projection wavelength and the particle 3D linear momentum. **Planck's constant ensures that for the 3D observed mass and velocity, the de Broglie wavelength will match it fundamental dilaton 3D projection.** Mass is considered to be proportional to dilator maximum 4D volume. Calibration is made to replicate Gauss' electrostatics law, Newton's gravitational law and Biot-Savart law of magnetism. Since mass is proportional to a 4D volume and volume depends upon lengths, which are Lorentz invariant , the 4D-mass volume representation is also Lorentz invariant. 4D-mass is defined as being the total mass or 4D volume displaced in an oscillation cycle. Since the dilator oscillates between states corresponding to an electron and a proton, its 4D mass will be one atomic mass unit. 3D-mass is the mass or 4D displacement volume perceived in the 3D Space at given phases of the de Broglie expansion.

Dilators with spin zero are modeled to couple with superficial wave, and thus their position changes from one de Broglie cycle to the next just by the displacement governed by a new quantum Lagrangian principle. Its propagation direction continues to be perpendicular to the 3D universe hypersurface. Dilators with non-zero spin are modeled to couple with volumetric wave, and their position changes from one de Broglie cycle to the next just by the displacement governed by the Lagrangian principle. In addition, its propagation direction is redirected by the

angle covered by this transition. Since the change in angle is defined with respect to the last step k-vector, charged particles are to sense a much higher acceleration than zero spin particles (matter). **This is the proposed reason behind the strength difference between gravitation and electromagnetic Forces.**

2.8 Cosmological Coherence

The coordinated actions of dilators implicit in the proposed Lagrangian principle mean that even though the dilator is a 5D spacetime wave generator it behaves as a wave, thus implicitly replicating wave behavior. Its position is determined at each de Broglie step according to the local dilaton environment.

The concept of 4D spacetime deformation coherences generating waves is created in analogy with electromagnetic waves being created by electronic coherences. In the case of spacetime coherences, the coherences for the fundamental dilator (proton-electron dilator) are never dephased. Dephasing would result in proton or electron decay or disappearance. The states corresponding to the proton and to the electron are considered to be the ground states for each one of the two wells, thus they cannot decay further, only dephase.

All matter in gravitational and electromagnetism studies here modeled are composed of protons, electrons and neutrons, thus are composed of this fundamental dilator. Although current understanding of charged particles associates with them a gravitational mass, their gravitational field could never be measured. If it were to exist, their electric field would be 10^{36} times larger than their gravitational field.

In this model, charged particles have no gravitational field, since in this model there is only one kind of interaction and two kinds of responses.

The Quantum Lagrangian Principle means that all matter, charged or not, is synchronized with the surrounding dilatons, thus generating a cosmological coherence.

This idea of a cosmological or macroscopic coherence might seem unexpected but it is built-in in the concept of field. Fields are constructs derived from electromagnetism and gravitation equations. In a purely geometrical theory, which has been the goal of many scientists and philosophers for thousands of years, there should be only a few constructs: space, space wave (metric modulations), and local and global symmetry rules (angular and linear momentum conservation) adapted to the appropriate constructs. There shouldn't be mass or charge in a purely geometrical theory, only displacement volume and phase. Returning to the concept of fields, when one consider gravitation/electrostatics to be an extensive properties of mass/charge, one is implicitly adding the corresponding wave amplitudes within an implicit geometrical theory without regard to their phases, that is, fields imply coherences. This is a fine point that has been missed since nobody planned to eliminate the concept of mass and charge to build a geometrical theory. Einstein's gravitation theory used mass to deform spacetime. Kaluza-Klein also used mass to deform spacetime and created a compact dimension to store the electromagnetic fields. In this theory, coherent dilatons controls dilators motions in a mutually consistent cosmic symphony.

Figure 3 displays two inertial systems with the same origin. System with distinct origins would have an additional phase-shift due to the retarded potential interaction. This is the reason why all the waves in a multi-particle body can have their amplitudes added together, as opposed to having their amplitudes averaged out to zero due to a random phase relationship. It shows that a particle state of motion does not modify its phase relationship with the expanding hypersurface (3D Universe). The particle is always phase matched to the rest of the universe. This is the meaning of physical existence. Our concept of existence is based on interaction. If a particle had a de

Broglie wavelength different from the one of the fundamental dilator, its interaction would average out to nothing. No interaction means no material existence. A neutrino is an almost perfect example of this pattern – it still interacts a little. The phase matching condition implies that the entire universe is in phase (lived the same number of de Broglie cycles) as it propagates along the radial direction R. This also means that the universe is thin along the radial direction of propagation (much less than one de Broglie wavelength thin).

The number of de Broglie cycles a particle passes through is independent upon the angle α (relative velocity). This means that any dilator of a given type is always in phase with another of the same type, irrespectively of its trajectory through the universe. It also means that protons, electrons, neutrons created in the dawn of the universe kept the same phase relationship with all the other protons, electrons and neutron of the universe throughout the ages. The same is true for any particle created at any time. De Broglie wavelength, phase and intensity are properties shared by particle classes.

This coherence is essential in creating a quantum gravity theory and it is essential to the hypergeometrical theory. In fact, cosmological coherence is a hypothesis and a corollary of the hypergeometrical theory, because one could not construct a geometrical theory without a cosmological coherence due to the extensive property of gravitational, electrostatic and magnetic fields.

2.9 Quantization of Time and the Fat Electron

The theory makes use of a fat electron, that is, a one atomic mass unit electron in the derivations on sections 3.1 and 3.2.

The derivations are done in the 5D spacetime and yield the acceleration for a single particle subject to one kilogram mass or to one kilogram of charge. Notice that acceleration is not force. To obtain a force, which is a 3D concept, one has to multiply by a 3D mass. To understand why one would use a one atomic mass unit electron, and what are the 3D and 4D masses, one has to see the process in 4D. First one needs to understand neutron decay to have some representation of the electron and proton 4-D deformational states.

The hypergeometrical standard model for the neutron decay process is shown next:

neutron -> proton + electron + anti-neutrino

Where the 4D deformation states are given:

(2/3,-1/3,-1/3) -> (2/3, 2/3,-1/3) + (0,-2/3,-1/3) + (0,-1/3, 1/3) (2.20)

respectively.

Conversely:

proton + electron -> neutron + neutrino

(2/3, 2/3,-1/3) + (0,-2/3,-1/3) -> (2/3,-1/3,-1/3) + (0,1/3, -1/3) (2.21)

The representation of the neutron decay is presented here just to showcase how one thinks about nuclear chemistry in the hypergeometrical universe framework. The "quark" numbers are not meant to be considered the quark composition of the particles. It is an equation of 4D volume conservation and the numbers represent the three axis lengths of a 4D ellipsoid of revolution. Negative numbers just means that they have opposing phases. The total 4D volume of all particles in the universe should add up to zero. Any particle can be described through these types of equations and that will be discussed elsewhere. Notice that no number was given to the fourth dimension. There is no mentioning of the residual length of the fourth coordinate for simplicity,

but it is certainly smaller than the others, thus the resulting skinny profile when the dilator is rotated by 90 degrees. This assignment was done considering the lowest 4D volumes or lowest numbers, the number **ONE** can be decomposed for representing the nuclear reaction (neutron decay).

This is clearly unorthodox, since the electron is not supposed to have a quark composition.

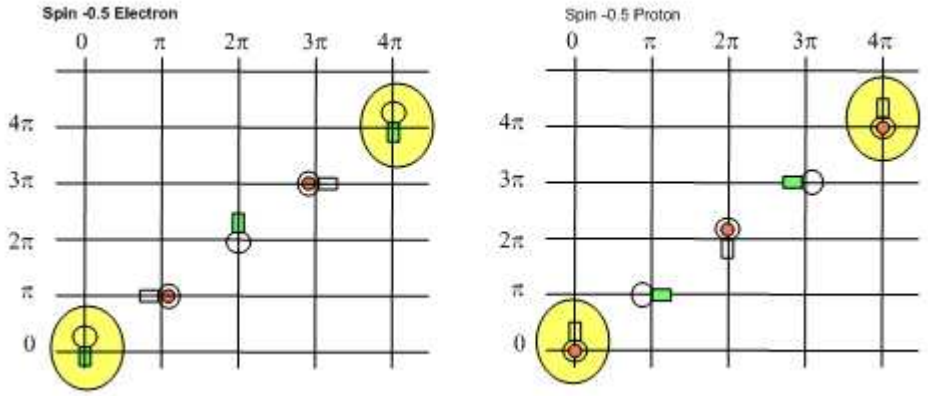

Figure 4. The figure above show an electron-proton dilator as it tumbles during two de Broglie wavelength universe expansion, with the two possible initial phases. The left (right) scheme corresponds to an electron (proton).

The red dot indicates that the coherence is on the proton side (2/3, 2/3,-1/3), while the green rectangle indicates that the coherence is on the electron side (0,-2/3,-1/3). Spin has been modeled as an extrinsic rotation perpendicular to RX. Spin half (N) means that the dilator performs half (N) rotational cycle for each de Broglie expansion step. Notice that the representation of spin as a 4D rotation is distinct from orbital momentum L and total Momentum J. This is a four-dimensional space theory and one has to have angular momentum conservation in four dimensions, thus the rules for total angular momentum conservation are valid.

Orbital momentum L and total angular momentum J are 3D concepts and will result from the projection of the equations of motion solution on the 3D hypersurface. Quantum mechanics replication is outside the scope of this paper. The behavior required by the quantum Lagrangian principle has the similar traits to the Bohr model. If one considers that in the prescribed QLP 4D trajectories, the electron riding the 4D dilaton wave will also ride its 3D projection -the corresponding de Broglie matter wave- then it becomes clear that QLP will immediately reproduce the Bohr hydrogen model and more.

2.9.1 3D and 4D Masses

Now one can define the 3D and 4D masses. From Figure 4, it is clear that what distinguishes an electron from a proton is a rotational (spin) phase. This means that our 3D interactions (material existence) support a pseudo time-quantization or intermittent interaction on quantized time steps. Thus 3D masses are the masses one observes at de Broglie expansion phases 0, $2\boldsymbol{\pi}$, $4\boldsymbol{\pi}$…. It is worthwhile to notice that on the de Broglie expansion phases $\boldsymbol{\pi}$, $3\boldsymbol{\pi}$, $5\boldsymbol{\pi}$.. (when the dilator character changed totally and the 4D volume reaches a maximum) the 3D projection is minimal. In the case of an electron, the de Broglie expansion phase $\boldsymbol{\pi}$ corresponds to a skinny or laying down proton (nothing to grab). In this work, we are not presenting the equations of motion of the 4D tunneling rotor, since they are not necessary for the understanding of the physical model. They are not needed either for the proposed grand unification theory. One only needs to know that 4D volumes are associated with electrons and protons and that electrons and protons are the two sides of the tunneling system. One also has to keep in mind that the 3D projection of this 4D volume is proportional to the corresponding 3D mass or simply particle mass. The derivation of

3D volumes from 4D volumes is done through simple local Cartesian projections, thus are trivial. The detailed shape of these states also doesn't matter for this discussion. One only needs to know that the thickness (radial dimension thickness) of these states is much smaller than the de Broglie (Compton) wavelength of the dilator (one a.m.u. particle) to understand that when the tunneling rotor (dilator) is rotated by 90 degrees, it should show a much smaller volume from the perspective of the 3D universe.

What would be the meaning of a 4D Mass?

Remember that in a geometrical theory, mass has to be related to a 4D displacement volume. From the point of view of four-dimensional waves being generated by coherently located dilators, it doesn't matter if the proton or electron are standing up or laying down, the 4D volume is the same. This means that the 4D mass of an electron is equal to the 4D mass of a proton - approximately one atomic mass unit. One atomic mass unit corresponds to a standing-up proton and a standing-up electron which is the exactly the mass of a hydrogen atom. This is an approximation because of the relativistic shrinking of volume as a function of relative motion. The correction factor should be, in terms of 4D volumes, equal to (standing-up electron + laying-down proton)/(standing-up electron + standing-up proton). In other words, a standing-up electron (proton) has a different perceived 4D volume than a laying-down electron (proton). This correction factor should be related to the electron gyromagnetic ratio. From there, one should be able to derive an instantaneous tangential speed. For sake of completeness, I will present briefly the other relevant particles:

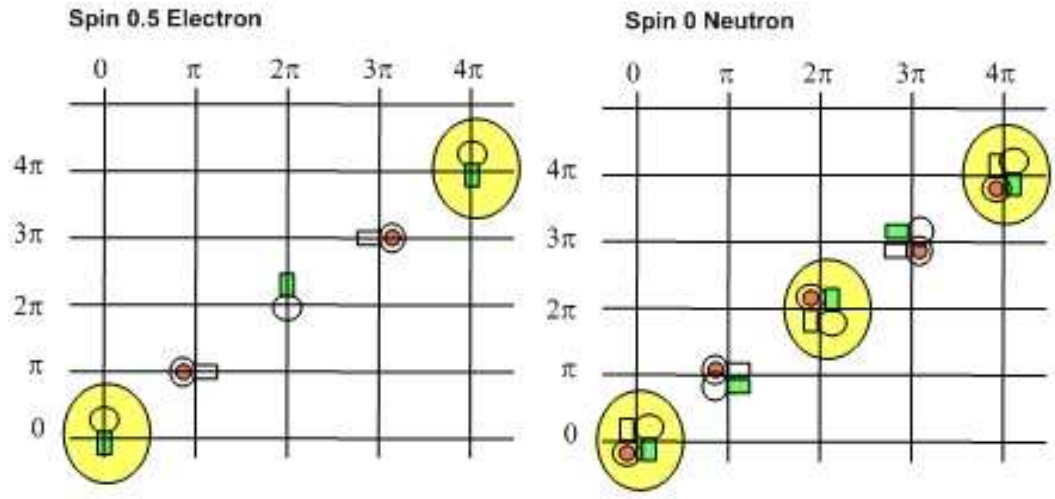

Figure 5. The left (right) scheme corresponds to a spin-plus half electron (spin-zero neutron).

A zero spin neutron is just a combination of the two dilator rotational states such that the total angular momentum and charge is zero. Its physical meaning is a transition state in the nuclear chemistry reaction described in equation (2.21). It is also, the closest representation to the archetypical gravitational particle. In this theory, electrons and protons join to form neutral matter. Neutral, zero spin matter is the matter that shows only gravitation. Figure 5 shows how the rotating dilator would interact to create this state. It is shown to showcase reasoning behind Hund's law. Hund's law states that particles should form pairs of zero spin, that is, one electron of spin +0.5 joins another with spin -0.5 in and electronic orbital. This is supposed to have a lower energy than if you put each electron by itself in each orbital. Figure 6 shows a spin -0.5

neutron, the only one observed in nature. It seems that the neutron as a whole is rotating, but this corresponds to a combination of a spin +0.5 proton with a spin +0.5 electron. Since this combination is the only one observed in nature, it should mean that it has higher energy or higher 4D volume. Remember that one is considering the reaction in reverse, that is, one is considering adding one electron to a proton to yield a neutron and a neutrino- an endothermic reaction.

The difference in energy or conversely 4D volume is the emitted neutrino described in equation (2.21). The neutrino also carries the extra angular momentum.

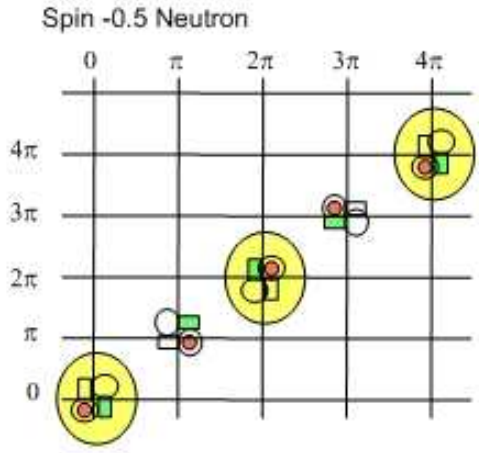

Figure 6. The figure above shows an electron-proton dilator dimmer (neutron) as it tumbles during a two-de-Broglie-wavelength universe expansion. The scheme corresponds to spin-minus half neutron.

If one adds a Spin -0.5 proton to a Spin +0.5 electron you get a Spin 0 neutron, which subsequently decays and emits a neutrino. The neutrino corresponds to the transition from spin-zero to a spin-half neutron. Since one would expect that the change in volume between the two states to be minimal, the neutrino is expected to have a lower tunneling frequency and thus being non-interacting, in fact, very little interaction, massless, chargeless and thus immaterial.

Normally, one only speaks of spin projections along the 3D space directions. Since one has a physical model of a tumbling 4D dilator in a 4D space one has to define a direction of motion. Negative and positive spins are assigned to clockwise and counterclockwise rotations to keep angular momentum conservation in the 4D space. Antiparticles differ from their counterparties just by a 180 degrees dilation phase shift. Other nuclear chemistry reactions should have similar representation being the only difference the dilator coherence.

2.10 The Meaning of a Charge

From section 2.9 it becomes obvious what is the meaning of a charge. It is only the in-phase sign of the dilation. A proton is positive because it is dilated as a proton – it has proton 3D mass or proton 4D Volume, when observed by the shock wave universe. An anti-proton would have the same 3D mass but the 4D displacement volume would be negative, that is, the modulation in metric had the opposite effect on 4D Space. The difference in 4D Volume on specific phases is why a proton and an electron do not annihilate each other, as do a proton and an anti-proton.

3 Force Unification

3.1 Quantum Gravity and Electrostatic Interaction

Let's consider a body and a particle interacting through their four-dimensional waves. The body will always have a kilogram (of mass or charge) and the particle will always be a one a.m.u. (atomic mass unit) particle (~neutron). For the gravitational interaction, this particle will have zero spin, while it will have spin half for the electrostatic interaction. Although the four-dimensional wave interaction is taking place on the hypersurface of a four-dimensional expanding hypersphere, one will make use of cross-sections to calculate interference patterns. Interference is considered on each de Broglie expansion of the hyperspherical universe. Notice that spacetime waves and their sources will be described in detail in a paper of this series. One can briefly describe the source of waving as a four-dimensional particle (four-dimensional ellipsoid of

revolution or particle X for simplicity). The X particles are characterized by four axes lengths. Three axes lengths correlate with the quarks composition of matter. The fourth-axis always points in the radial time direction. Needless to say, different quarks (axis lengths) and different rotational states around the four axis will be sufficient to maps all known particles (photons, mesons, neutrinos, etc). Volume (mass) tunnels in an out of the three-dimensional space for spinning particles (particles with non-zero spin) and out and in towards the radial time dimension. Spin is considered to be a special rotation, since the rotation axis is perpendicular to radial time and one of the spatial coordinates. That gives spinning a different effect; it brings the particles in and out of the fabric of space, thus allowing for a realignment of the k-vector of associated spacetime waves. Let's consider the interaction through a two-dimensional cross-section (X x τ). Particle one (one a.m.u "zero spin neutron" or fat electron) sits on x=0, while particle two (the body of 1 Kg) sits on $x=R_0$. The four-dimensional dilatons are embedded in a fifth dimension (cosmological time). A position in this space is defined by the following vector:

$$\vec{r} = \begin{pmatrix} r.\alpha \\ r.\beta \\ r.\gamma \\ \tau \\ \Phi \end{pmatrix} \text{ using director cosines } \alpha, \beta \text{ and } \gamma. \tag{3.1}$$

At time zero, the positions for particles 1 and 2 are given by:

$$\vec{r}_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \quad \text{and} \quad \vec{R} = \begin{pmatrix} R \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \tag{3.2}$$

After a de Broglie cycle, one has these three vectors:

$$\vec{r}_0(\lambda_1) = \begin{pmatrix} 0 \\ 0 \\ 0 \\ \lambda_1 \\ \lambda_1 \end{pmatrix} \quad \text{and} \quad \vec{r} = \begin{pmatrix} r \\ 0 \\ 0 \\ \lambda_1 \\ \lambda_1 \end{pmatrix} \quad \text{and} \quad \vec{R} = \begin{pmatrix} R \\ 0 \\ 0 \\ \lambda_1 \\ \lambda_1 \end{pmatrix} \tag{3.3}$$

$\vec{r}_0(\lambda_1)$ is the unperturbed crest of the four-dimensional wave of particle 1 after a de Broglie cycle. $\vec{r}$ is the position of the same crest under the influence of particle 2.

The k-vector is given by:

$$\vec{k} = g_{ij}.k^j = \frac{2\pi}{\lambda} \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \\ 1 \\ \frac{1}{2} \end{pmatrix} = \frac{2\pi}{\lambda} \begin{pmatrix} 1 \\ 0 \\ 0 \\ -1 \\ \frac{1}{2} \end{pmatrix} \tag{3.4}$$

Where g_{ij} is the local metric of the five-dimensional space. Again, cosmological distances would require a further refinement and the usage of a non-local metric. This is not required in the calculation of near-proximity forces. In the derivation of the Biot-Savart law, g_{ij} will be rewritten with regard the corresponding non-zero relative speeds. Notice the ½ phase dependence on k-vector, corresponding to the fifth dimension for a half-spin fat electron.

And

$$\vec{k} = \frac{2\pi}{\lambda}\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix} = \frac{2\pi}{\lambda}\begin{pmatrix} 1 \\ 0 \\ 0 \\ -1 \\ 0 \end{pmatrix} \tag{3.5}$$

for a "static zero spin neutron " forward time traveling wave. Notice that the dilaton and the dilator are treated as one due to the QLP. Where

- N=1Kg of Matter ≅1000 Avogrado's Number=6.0221367360E+26 particles of type 1.
- $\lambda_1 \cong$ h*1000*Avogrado/(1 Kg x c)= 1.3310E-15 meters (in the MKS system).
- $\lambda_2=\lambda_{1Kg}\cong$ h/(1Kg x c)= 2.2102E-42 meters (in the MKS system).
- $G_{Gravitational}$ is the gravitational constant = 6.6720E-11 $m^3.Kg^{-1}.s^{-2}$
- Single electric charge ($1.6022E-19$ Coulomb).
- q_e is the effective value of the single electric charge= charge divided by a corrective factor of 1.004145342= 1.59556231E-19 Coulomb
- ε_0=permittivity of the vacuum = 8.8542E-12 $C^2.N^{-1}.m^{-2}$ (MKS)

Starting with the standard MKS equation for electrostatic force between two one Kg bodies of electrons (one a.m.u. "electrons" or "protons") = x Coulombs, one obtains:

$$F_{Electrostatic} = \frac{1}{4\pi\varepsilon_0}\frac{(xCoulomb)^2}{1meter^2} = \frac{1}{4\pi\varepsilon_0}\left(\frac{N}{1Kg}1Kg\right)^2\frac{(q_e * Coulombs * per * particle)^2}{1meter^2}$$

$$F_{Electrostatic} = \frac{1}{4\pi\varepsilon_0}\left(\frac{N}{1Kg}(q_e * Coulombs * per * particle)\right)^2\frac{(1Kg)^2}{1meter^2}$$

$$G_{Electrostatic} = \frac{1}{4\pi\varepsilon_0}(N.q_e)^2 = 8.29795214\text{E}+25 \tag{3.5}$$

$$\frac{G_{Electrostatic}}{G_{Gravitational}} = \frac{8.29795214\text{E}+25}{6.672E-11} = 1.24369786\text{E}+36 \tag{3.6}$$

The dilaton for a single particle can be represented by:

$$\psi_1(x,y,z,\tau,\Phi) = \frac{\cos(\vec{k}_1.\vec{r})}{1+P.f(\vec{k}_1,\vec{r}-\vec{r}_0)} \tag{3.7}$$

where

- || means absolute value
- $f(\vec{k}_1,\vec{r}) = \theta\left(\left|\vec{k}_1.\vec{r}\right| - 2\pi\right)\left|\vec{k}_1.\vec{r}\right|$
- Where θ is the Heaviside function.
- P (absolute value of the phase volume) is 3.5 for a particle with spin half and 3 for neutral matter. The meaning of P is that for one de Broglie wavelength traversed path by the hyperspherical universe, a propagating spacetime wave spread along by a factor of P2π (7π for charged particles and 6π for neutral-zero spin matter).

Similarly, for a 1 Kg body located at position $\vec{R}$:

$$\psi_2(x,y,z,\tau,\Phi) = \frac{M.N.\cos(\vec{k}_2.(\vec{R}-\vec{r}))}{1+P.f(\vec{k}_2,\vec{R}-\vec{r})} \tag{3.8}$$

where the effect of the 1 kg mass is implicit in the k_2-vector and expressed by the factor N. The wave intensity scales up with the number of particles (N). One kilogram of mass has 1000 moles of 1 a.m.u. "zero-spin neutrons", or $|k_2|$ = 1000.Avogadro. $|k_1|$=N. $|k_1|$, where

- M=1 for neutral matter-matter or antimatter-antimatter interactions or opposite charge interactions
- M=-1 for neutral matter-antimatter interactions or same charge interactions

To calculate the effect of gravitational/electrostatic attraction, one needs to calculate the displacement on the crest of each particle or body wave due to interaction with the dilatons generated by the other body.

This is done for the lighter particle, by calculating the derivative of the waveform and considering the extremely fast varying gravitational wave from the macroscopic body always equal to one, since the maxima of these oscillations are too close to each other and can be considered a continuum.

The total waveform is given by:

$$\psi_{total}(x,y,z,\tau,\Phi) = \frac{\cos(\vec{k}_1.\vec{r})}{1+P.f(\vec{k}_1,\vec{r}-\vec{r}_0)} + \frac{M*N}{1+P.f(\vec{k}_2,\vec{R}-\vec{r})} \tag{3.9}$$

The term $f(\vec{k}_2,\vec{R}-\vec{r})$ contains the treatment for retarded potentials, but for simplicity we will neglect differences in dimensional time between $\vec{R}$ and $\vec{r}$. Equation (3.9) is the one and only unification equation, that is, it is the four-dimensional wave equation that yields all the forces, when one consider four-dimensional wave constructive interference. It shows that anti-matter will have gravitational repulsion or anti-gravity with respect to normal matter. The derivative for ψ_1 is given by:

$$\left.\frac{\partial\psi_1(x,y,z,\tau,\Phi)}{\partial x}\right|_{\tau=\lambda_1} \cong -{k_1}^2 r \tag{3.10}$$

$\nabla\left(P.f(\vec{k}_1,\vec{r}-\vec{r}_0)\right) = 0$ due to $\left|\vec{k}_1.\left(\vec{r}-\vec{r}_0\right)\right| << 2\pi$.

Similarly

$$\left.\frac{\partial \psi_2(x,y,z,\tau,\phi)}{\partial x}\right|_{\tau=\lambda_1} \cong \frac{N*M}{Pk_2.R^2} \tag{3.11}$$

Solving for x:

$$x = \frac{N}{Pk_1^{\,2}k_2.R^2} = \frac{\lambda_1^{\,2}\lambda_2 N*M}{P(2\pi)^3 R^2} \tag{3.12}$$

There are two regimen of spacetime travel and they are depicted in Figure 7 below:

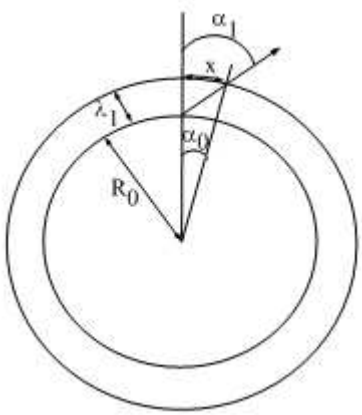

Figure 7. This figure shows the geometry of a surface bound particle. This is a X versus τ cross-section of the hyperspherical expanding universe. Notice that the two circles represent a one de Broglie expansion of the hyperspherical universe.

At each de Broglie step both types of particles (zero and non-zero) change position by the same amount x and that defines a change in k-vector direction. The difference is with which referential that change in angle occurs. In the case of volumetric waves (non-zero spin particles), the k-vector is allowed to change by the angle α_1, while in the case of superficial waves (zero spin particles), the k-vector changes just by the amount given by α_0 since its k-vector has to remain perpendicular to the fabric of space. Tan(α) is given by tan(α_1) =x/λ_1 or by tan(α_0) =x/λ_1*(λ_1/R_0) depending upon if the interaction is such that the particle k-vector shifts as in α_1 or it just acquires the radial pointing direction as in α_0. A further refinement introduced by equation (3.13) below introduces a level of local deformation of the de Broglie hypersurface or fabric of space. A change in angle α_0 corresponds to a much smaller angle change between the radial directions (by a factor λ_1/R_0 = 9.385E-42, with R_0 (circa 15 billion light-years) as the dimensional age of the Universe). The experimental spacetime torsion due to gravitational interaction lies someplace in between 1 and 10^{-41}, thus showcasing a level of local deformation of the fabric of space. From figure 7, one calculates tan(α) as:

$$\tan(\alpha) = \frac{x}{\lambda_1}\delta = \frac{\lambda_1\lambda_2 N}{P(2\pi)^3 R^2}\delta \tag{3.13}$$

Where $9.385.10^{-42} = \frac{\lambda_1}{R_0} \le \delta \le 1$ and M=1. It will be shown that the upper limit is valid for charged particle interaction, while the lower limit modified by a slight deformation of the fabric of space will be associated with gravitational interaction. For the case of light, one has the following equation:

$$\tan(\alpha_0) = 1 \tag{3.14}$$

That is, light propagates with proper time projection/propagation direction τ at 45^0 with respect to the radial time/direction. To calculate the derivative of tan (α) with respect to τ, one can use the following relationship:

$$\frac{\partial}{\partial \tau}\tan(\alpha_0)=\frac{\tan(\alpha_0)}{\lambda_1}=\frac{\lambda_2 N}{P(2\pi)^3 R^2}\delta \tag{3.15}$$

Acceleration is given by:

$$a=c^2\frac{\partial}{\partial \tau}\tan(\alpha_0)=\frac{c^2\lambda_2 N}{P(2\pi)^3 R^2}\delta \tag{3.16}$$

To calculate the force between two 1 Kg masses (1000 moles of 1 a.m.u. particles) separated by one meter distance one needs to multiply equation (3.15) by 1Kg (N particles/Kg* 1Kg):

$$F = G_{Calculated}\ (\delta)\frac{(1Kg)^2}{(1meter)^2}=-\frac{c^2\lambda_2 *\left(\frac{N}{1Kg}\right)^2}{P(2\pi)^3}\delta\frac{(1Kg)^2}{(1meter)^2} \tag{3.17}$$

For δ=1 and P=3.5 one obtains the $G_{Electrostatic}$ (3.5).

$$G_{Calculated}\ (\delta=1)=\frac{c^2\left(\frac{N}{1Kg}\right)\lambda_1}{P(2\pi)^3}=8.29795214E+25=G_{Electrostatic} \tag{3.18}$$

Where one made use of $\lambda_1=N\lambda_2$ and considered the absolute value. It is important to notice that the derivation of the $G_{Calculated}$ never made use of any electrostatic property of vacuum, charge etc. It only mattered the mass (spacetime volumetric deformation) and spin. Of course, one used the Planck constant and the speed of light and Avogadro's number. **By setting δ=1 one recovers the electrostatic value of G!**

To analyze gravitational interaction, let's consider that Hubble coefficient measurements estimate the universe as being around 15 Billion Years old or 1.418E26 meters radius. To obtain the elasticity coefficient of spacetime, let's rewrite $\delta=(\lambda_1/R_0)\xi$ on equation (3.17) and equate the $G_{Calculated}$ to $G_{Gravitational}$ for two bodies of 1 Kg separated by 1 meter.

$$F = G_{Gravitaion\ al}=-6.6720\ \ E\text{-}11\frac{(1Kg)^2}{(1meter)^2}=-\frac{c^2\left(\frac{N}{1Kg}\right)\lambda_1}{P(2\pi)^3}\frac{\lambda_1}{R_0}\xi\frac{(1Kg)^2}{(1meter)^2} \tag{3.19}$$

Where P =3 since we are considering a spin-zero interaction. Solving for ξ:

$$\xi=\frac{P(2\pi)^3 R_0 G_{Gravitaion\ al}}{c^2\left(\frac{N}{1Kg}\right)\lambda_1^2}=8.567\times 10^{-4} \tag{3.20}$$

If we consider that the force is given by mass times acceleration:

$$F=m_{Mass}a_x=m_{Mass}c^2\frac{\partial\tan(\theta)}{\partial\lambda}=\frac{m_{Mass}c^2}{\lambda_1^2}\frac{\lambda_1}{R_0}\xi.x \tag{3.21}$$

$$F=\frac{m_{Mass}c^2}{\lambda_1 R_0}\xi.x=m_{Mass}\left(2\pi.\Omega^G Universe\right)^2.x \tag{3.22}$$

The natural frequency of spacetime oscillations is:

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$$\Omega^{G}_{Universe} = \frac{1}{2\pi}\sqrt{\frac{c^2\xi}{\lambda_1 R_0}} = 32.14\ \text{KHz} \tag{3.23}$$

Notice that this is not dependent upon any masses. That should be the best frequency to look for or to create gravitational waves. Of course, Hubble red shift considerations should be used to determine the precise frequency from a specific region of the universe. At last one can calculate the value of the vacuum permittivity from equations (3.5) and (3.18) as:

$$\varepsilon_0 = \frac{7\pi^2 N q_e^{\ 2}}{c^2 \lambda_1} = 8.85418782 \quad \text{E - 12} \tag{3.24}$$

Not surprisingly, there is a perfect match between theoretical and experimental (8.85418782E-12 $C^2.N^{-1}.m^{-2}$) values. The correction factor used to calculate the effective charge per particle is due to the effect of non-zero spin on matter, thus related to the particle gyromagnetic ratio. It is important to notice that this derivation don't use any parameterization. The "gyromagnetic ratio" and the "FS elasticity" are predictions of the theory, which uses only electron charge, speed of light, Avogadro's number and Planck's constant to relate it to non-hypergeometrical physics.

The complete gravitation equation is given by:

$$F_{Gravitaional} = \left[\frac{c^2\left(\frac{N}{1Kg}\right)\lambda_1}{P(2\pi)^3}\frac{\lambda_1}{R_0}\xi\right]\frac{m_1 m_2}{R^2} \tag{3.25}$$

Quantum aspects can be recovered by not using fast oscillation approximations. It is also important to notice that equations (3.8) and (3.9) can be used to calculate the interaction between any particles (matter or anti-matter) or to perform quantum mechanical calculations in a manner similar to molecular dynamic simulations. The quantum character is implicit in the de Broglie wavelength stepwise quantization. It is also relativistic in essence, as it will become clear when one analyzes magnetism next.

3.2 Magnetic Interaction

The Derivation of the Biot-Savart Law

Let's consider two wires with currents i_1 and i_2 separated by a distance R. Let's consider i_2 on the element of length dl_2 as the result of a moving charge of mass of 1Kg of fat electrons (one a.m.u. electrons). This is done to obtain the correct scaling factor.

Without loss of generality, let's consider that the distance between the two elements of current is given by:

$$\vec{R} = \frac{R}{\sqrt{3}}\begin{pmatrix}1\\1\\1\\0\\0\end{pmatrix} = R\hat{I} \qquad \text{and} \qquad \vec{r}_0 = \begin{pmatrix}0\\0\\0\\0\\0\end{pmatrix} \tag{3.26}$$

The velocities are:

$$\vec{V}_1 = v_1 \begin{pmatrix} \alpha_1 \\ \beta_1 \\ \gamma_1 \\ 0 \\ 0 \end{pmatrix} \quad \text{and} \quad \vec{V}_2 = v_2 \begin{pmatrix} \alpha_2 \\ \beta_2 \\ \gamma_2 \\ 0 \\ 0 \end{pmatrix} \tag{3.27}$$

Due to the spin half, one has after a two de Broglie cycles:

$$\vec{r} = \begin{pmatrix} \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\alpha_2\sqrt{3}) \\ \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\beta_2\sqrt{3}) \\ \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\gamma_2\sqrt{3}) \\ 2\lambda_1 \\ 2\lambda_1 \end{pmatrix} \quad \text{and} \quad \vec{R} = \begin{pmatrix} \frac{R}{\sqrt{3}} \\ \frac{R}{\sqrt{3}} \\ \frac{R}{\sqrt{3}} \\ 2\lambda_1 \\ 2\lambda_1 \end{pmatrix} \quad \text{and} \quad \vec{r}_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 2\lambda_1 \\ 2\lambda_1 \end{pmatrix} \tag{3.28}$$

Since one expects that the motion of particle 2 will produce a drag on the particle 1 along particle 2 direction of motion.
The figure below showcase the geometry associated with these two currents.

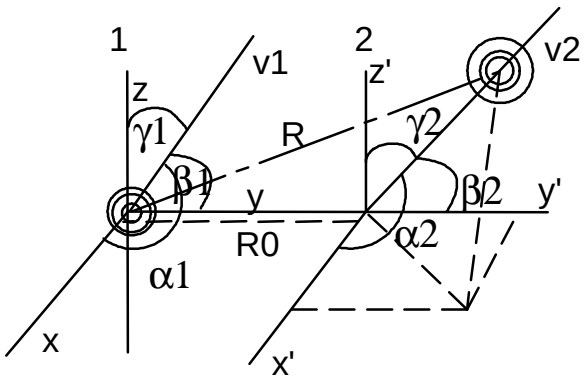

Figure 8. Derivation of Biot-Savart law using spacetime waves.
Notice also that the effect of the ½ spin is to slow down the rate of phase variation along the dimensional time τ in half.

In the case of currents, the velocities are not relativistic and one can make the following approximations to the five-dimensional rotation matrix or metric: $\cosh(\alpha) \cong 1$ and $\sinh(\alpha_i) \cong v_i/c$ where v_i is the velocity along the axis i.

The k-vectors for the two electrons on the static reference frame are given by:

$$\vec{k}_1 \cong \frac{2\pi}{\lambda_1}\begin{bmatrix} 1 & 0 & 0 & -\alpha_1\frac{v_1}{c} & 0 \\ 0 & 1 & 0 & -\beta_1\frac{v_1}{c} & 0 \\ 0 & 0 & 1 & -\gamma_1\frac{v_1}{c} & 0 \\ -\alpha_1\frac{v_1}{c} & -\beta_1\frac{v_1}{c} & -\gamma_1\frac{v_1}{c} & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} \\ -1 \\ \frac{1}{2} \end{bmatrix} \cong \frac{2\pi}{\lambda_1}\begin{bmatrix} \frac{1}{\sqrt{3}}+\alpha_1\frac{v_1}{c} \\ \frac{1}{\sqrt{3}}+\beta_1\frac{v_1}{c} \\ \frac{1}{\sqrt{3}}+\gamma_1\frac{v_1}{c} \\ -\left(\alpha_1\frac{v_1}{c}+\beta_1\frac{v_1}{c}+\gamma_1\frac{v_1}{c}\right)-1 \\ \frac{1}{2} \end{bmatrix} \tag{3.29}$$

Similarly:

$$\vec{k}_2 \cong \frac{2\pi}{\lambda_2}\begin{bmatrix} \frac{1}{\sqrt{3}}+\alpha_2\frac{v_2}{c} \\ \frac{1}{\sqrt{3}}+\beta_2\frac{v_2}{c} \\ \frac{1}{\sqrt{3}}+\gamma_2\frac{v_2}{c} \\ -\alpha_2\frac{v_2}{c}-\beta_2\frac{v_2}{c}-\gamma_2\frac{v_2}{c}-1 \\ \frac{1}{2} \end{bmatrix} \tag{3.30}$$

The wave intensities at $\vec{r}$ are:

$$\psi_1(x,y,z,\tau,\Phi) = \frac{\cos(\vec{k}_1.\vec{r})}{1+P.f(\vec{k}_1,\vec{r}-\vec{r}_0)} \tag{3.31}$$

$$\psi_2(x,y,z,\tau,\Phi) = \frac{M.\cos(\vec{k}_2.(\vec{R}-\vec{r}))}{1+P.f(\vec{k}_2,\vec{R}-\vec{r})} \tag{3.32}$$

Where N= 1000 Avogadro, λ_1= de Broglie wavelength of a one a.m.u (atomic mass unit) particle, λ_2=de Broglie wavelength of a 1Kg particle= λ_1/N.

Now one can calculate:

$$\vec{k}_1.(\vec{r}-\vec{r}_0) \cong \frac{2\pi}{\lambda_1}\begin{bmatrix} \frac{1}{\sqrt{3}}+\alpha_1\frac{v_1}{c} \\ \frac{1}{\sqrt{3}}+\beta_1\frac{v_1}{c} \\ \frac{1}{\sqrt{3}}+\gamma_1\frac{v_1}{c} \\ \left(-\alpha_1\frac{v_1}{c}-\beta_1\frac{v_1}{c}-\gamma_1\frac{v_1}{c}\right)-1 \\ \frac{1}{2} \end{bmatrix}\begin{bmatrix} \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\alpha_2\sqrt{3}) \\ \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\beta_2\sqrt{3}) \\ \frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\gamma_2\sqrt{3}) \\ 0 \\ 0 \end{bmatrix} = \frac{2\pi r}{\lambda_1}\left(1+\frac{\vec{V}_1.\hat{R}}{c}+\frac{\vec{V}_2.\hat{R}}{c}+\frac{\vec{V}_1.\vec{V}_2}{c^2}\right) \tag{3.33}$$

$$\vec{k}_1.\vec{r} \cong \frac{2\pi r}{\lambda_1}\left(1+\frac{\vec{V}_1.\hat{R}}{c}+\frac{\vec{V}_2.\hat{R}}{c}+\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)+2\pi \tag{3.34}$$

$$\nabla\left(\vec{k}_1.(\vec{r}-\vec{r}_0)\right) = \nabla\left(\vec{k}_1.\vec{r}\right) \cong \frac{2\pi}{\lambda_1}\left(1+\frac{\vec{V}_1.\hat{R}}{c}+\frac{\vec{V}_2.\hat{R}}{c}+\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)\hat{R} \tag{3.35}$$

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$\nabla\left(P.f(\vec{k}_1,\vec{r}-\vec{r}_0)\right)\cong 0$ due to $\left|\vec{k}_1.\left(\vec{r}-\vec{r}_0\right)\right| << 2\pi.$

Similarly:

$$\vec{k}_2.\left(\vec{R}-\vec{r}\right)\cong\frac{2\pi}{\lambda_2}\begin{bmatrix}\frac{1}{\sqrt{3}}+\alpha_2\frac{v_2}{c}\\ \frac{1}{\sqrt{3}}+\beta_2\frac{v_2}{c}\\ \frac{1}{\sqrt{3}}+\gamma_2\frac{v_2}{c}\\ \left(-\alpha_2\frac{v_2}{c}-\beta_2\frac{v_2}{c}-\gamma_2\frac{v_2}{c}\right)-1\\ \frac{1}{2}\end{bmatrix}\begin{pmatrix}\frac{R}{\sqrt{3}}-\frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\alpha_2\sqrt{3})\\ \frac{R}{\sqrt{3}}-\frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\beta_2\sqrt{3})\\ \frac{R}{\sqrt{3}}-\frac{r}{\sqrt{3}}.(1+\frac{v_2}{c}\gamma_2\sqrt{3})\\ 0\\ 0\end{pmatrix}\cong\frac{2\pi R}{\lambda_2}\left(1+\frac{\vec{V}_2.\hat{R}}{c}\right) \tag{3.36}$$

$$\nabla\left(f(\vec{k}_2,\vec{R}-\vec{r})\right)\cong\frac{2\pi}{\lambda_2}\begin{bmatrix}\frac{1}{\sqrt{3}}+\alpha_2\frac{v_2}{c}\\ \frac{1}{\sqrt{3}}+\beta_2\frac{v_2}{c}\\ \frac{1}{\sqrt{3}}+\gamma_2\frac{v_2}{c}\\ \left(-\alpha_2\frac{v_2}{c}-\beta_2\frac{v_2}{c}-\gamma_2\frac{v_2}{c}\right)-1\\ \frac{1}{2}\end{bmatrix}\begin{pmatrix}-\frac{1}{\sqrt{3}}.(1+\frac{v_2}{c}\alpha_2\sqrt{3})\\ -\frac{1}{\sqrt{3}}.(1+\frac{v_2}{c}\beta_2\sqrt{3})\\ -\frac{1}{\sqrt{3}}.(1+\frac{v_2}{c}\gamma_2\sqrt{3})\\ 0\\ 0\end{pmatrix}=-\frac{2\pi}{\lambda_2}\left(1+\frac{\vec{V}_2.\hat{R}}{c}\right)\hat{R} \tag{3.37}$$

Hence:

$$\nabla\psi_1(x,y,z,\tau,\Phi)\cong-\frac{\nabla(\vec{k}_1..\vec{r})}{1+P.f(\vec{k}_1,\vec{r}-\vec{r}_0)}\sin(\vec{k}_1.\vec{r}) \tag{3.38}$$

$$\nabla\psi_1(x,y,z,\tau,\Phi)\cong-\left(\frac{2\pi}{\lambda_1}\right)^2\left(1+\frac{\vec{V}_1.\hat{R}}{c}+\frac{\vec{V}_2.\hat{R}}{c}+\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)^2 r\hat{R} \tag{3.39}$$

And

$$\nabla\psi_2(\vec{r},\tau,\Phi)\cong-\frac{P\nabla(f(\vec{k}_2,\vec{R}-\vec{r}))}{\left(1+P.f(\vec{k}_2,\vec{R}-\vec{r})\right)^2}=-\frac{1}{P\frac{2\pi}{\lambda_2}.\left(1+\frac{\vec{V}_2.\hat{R}}{c}\right)}\frac{\hat{R}}{R^2}\cong-\left(\frac{\lambda_2}{2\pi P}\right)\left(1-\frac{\vec{V}_2.\hat{R}}{c}\right)\frac{\hat{R}}{R^2} \tag{3.40}$$

Thus,

$$r\cong-\frac{\left(\frac{\lambda_2}{2\pi P}\right)\left(1-\frac{\vec{V}_2.\hat{R}}{c}\right)\frac{\hat{R}}{R^2}}{\left(\frac{2\pi}{\lambda_1}\right)^2\left(1+\frac{\vec{V}_1.\hat{R}}{c}+\frac{\vec{V}_2.\hat{R}}{c}+\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)^2}\cong-\left(\lambda_1^2\lambda_2\right)\frac{\left(1-\frac{\vec{V}_2.\hat{R}}{c}\right)\left(\hat{R}.\hat{R}-2\frac{\vec{V}_1.\hat{R}}{c}-2\frac{\vec{V}_2.\hat{R}}{c}-2\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)}{(2\pi)^3P}\frac{\hat{R}}{R^2} \tag{3.41}$$

$$r_{ee}\cong-\left(\lambda_1^2\lambda_2\right)\frac{\left(\hat{R}.\hat{R}-2\frac{\vec{V}_1.\hat{R}}{c}-2\frac{\vec{V}_2.\hat{R}}{c}-2\frac{\vec{V}_1.\vec{V}_2}{c^2}-2\frac{\vec{V}_2.\hat{R}}{c}+2\left(\frac{\vec{V}_1.\hat{R}}{c}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)+2\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)+2\left(\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\right)}{(2\pi)^3P}\frac{\hat{R}}{R^2} \tag{3.42a}$$

$$r_{ep} \cong +\left(\lambda_1^2\lambda_2\right)\frac{\left(\hat{R}.\hat{R}-2\frac{\vec{V}_1.\hat{R}}{c}\right)}{(2\pi)^3 P}\frac{\hat{R}}{R^2} \quad \text{since v2=0} \tag{3.42b}$$

$$r_{pe} \cong \left(\lambda_1^2\lambda_2\right)\frac{\left(\hat{R}.\hat{R}-2\frac{\vec{V}_2.\hat{R}}{c}-2\frac{\vec{V}_2.\hat{R}}{c}+2\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\right)}{(2\pi)^3 P}\frac{\hat{R}}{R^2} \quad \text{since v1=0} \tag{3.42c}$$

$$r_{pp} \cong \left(\lambda_1^2\lambda_2\right)\frac{\left(\hat{R}.\hat{R}\right)}{(2\pi)^3 P}\frac{\hat{R}}{R^2} \quad \text{since v1=v2=0} \tag{3.42d}$$

(3.42f)

$$r_{total} \cong r_{ee}+r_{ep}+r_{pe}+r_{pp} = -\left(\lambda_1^2\lambda_2\right)\frac{\left(2\left(\frac{\vec{V}_1.\hat{R}}{c}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)-2\left(\frac{\vec{V}_1.\vec{V}_2}{c^2}\right)\left(1-\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\right)\right)}{(2\pi)^3 P}\frac{\hat{R}}{R^2}$$

Where p stands for proton and e for electron.

$$r \cong -\left(\lambda_1^2\lambda_2\right)\frac{\left(-2\frac{\vec{V}_1.\vec{V}_2}{c^2}+2\left(\frac{\vec{V}_1.\hat{R}}{c}\right)\left(\frac{\vec{V}_2.\hat{R}}{c}\right)\right)}{(2\pi)^3 P}\frac{\hat{R}}{R^2} \tag{3.43}$$

$$r \cong 2\left(\lambda_1^2\lambda_2\right)\frac{\left(\left[V_1\otimes\left(V_2\otimes\hat{R}\right)\right].\hat{R}\right)}{(2\pi)^3 P c^2}\frac{\hat{R}}{R^2} \tag{3.44}$$

Where non-velocity dependent and single velocity dependent contributions where neglected due to the counterbalancing wave contributions from static positively charged centers.
The force is given by:

$$\vec{F} = c^2\frac{\partial\tan(\alpha)}{\partial\tau} = c^2\frac{r}{2\lambda^2_1} = \frac{\lambda_2}{(2\pi)^3 P}\left(\left[V_1\otimes\left(V_2\otimes\hat{R}\right)\right].\hat{R}\right)\frac{\vec{R}}{R^3} = \frac{\lambda_2 v_1.v_2}{(2\pi)^3 P}\left(\left[d\hat{l}_1\otimes\left(d\hat{l}_2\otimes\hat{R}\right)\right].\hat{R}\right)\frac{\vec{R}}{R^3} \tag{3.45}$$

Where one took into consideration that a particle with spin half has a cycle of 2 λ_1 instead of λ_1.
The Biot-Savart law can be written as:

$$d\vec{F} = \frac{\mu_0 I_1.I_2}{4\pi}\frac{(d\vec{l}_1.d\vec{l}_2)\vec{x}_{12}}{|\vec{x}_{12}|^3} \tag{3.46}$$

Comparing the two equations one obtains:

$$\frac{\mu_0}{4\pi} = \frac{\lambda_2}{(2\pi)^3 q_e^2 P} \tag{3.47}$$

Thus

$$\mu_0 = \frac{\lambda_2}{2\pi^2 q_e^2 P} \tag{3.48}$$

From equation (3.24)

$$\varepsilon_0 = \frac{2P\pi^2 N q_e^2}{c^2\lambda_1}$$

Thus

$$\mu_0.\varepsilon_0 = \frac{\lambda_2}{2P\pi^2 q_e{}^2}\frac{2P\pi^2 N q_e{}^2}{c^2\lambda_1} = \frac{1}{c^2} \tag{3.49}$$

Thus one recovers the relationship between μ_0 and ε_0.

3.3 Grand Unification Supersymmetry

As the dimensional age of the universe becomes smaller, the relative strength of gravitation interaction increases. Conversely, one expects that as the universe expands gravity will become weaker and weaker. This and the four-dimensional light speed expanding hyperspherical universe topology explain the acceleration of expansion without the need of anti-gravitational dark matter.

For gravitation the spring coefficient is given by:

$$F = m_{neutron} * a_x = m_{neutron}c^2\frac{\partial\tan(\theta)}{\partial\lambda} = \frac{m_{neutron}c^2}{\lambda^2{}_1}\frac{8.56610^4\lambda_1}{R_0}x = \kappa_g x \tag{3.50}$$

Similarly for electrostatic interaction, one has:

$$F = m_{neutron} * a_x = m_{neutron}c^2\frac{\partial\tan(\theta)}{\partial\lambda} = \frac{m_{neutron}c^2}{\lambda^2{}_1}x = \kappa_e x \tag{3.51}$$

Thus $\frac{\kappa_g}{\kappa_e} = \frac{8.56610^4\lambda_1}{R_0}$ (3.52)

Thus when R_0 was smaller than 8.56610^4 times λ_1 (3.8E-19s), gravitational and electromagnetic interactions had equal strength. They were certainly indistinguishable when the radius of the universe was one de Broglie wavelength long. This section is called Grand unification supersymmetry, because condition (3.52) plays the role of the envisioned group theoretical supersymmetry of the grand unification force in future theories. Of course, it has a geometrical interpretation. At that exact radius, an elastic spring constant of the fabric of space allows for a change in the local normal such that it is parallel to the redirection of k-vector of a freely moving dilator. This is not what most scientists in this field expected but science is not about expectations.

4 Conclusions:

The hypergeometrical theory, a model that considers the interference of four-dimensional wave on the hypersurface of a hyperspherical expanding universe was introduced.

The complexity of the present description of the universe in our sciences[4-6] is assigned to the fact that one is dealing with four-dimensional projections of a five dimensional process. Our inability to realize that made the description unnecessarily complex.

These are the ingredients for a new and simple formulation of Physics:

- A new quantum Lagrangian principle (QLP) was proposed.

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- Quantum gravity, electrostatics and electromagnetism were derived using the same equations (QLP), same framework. The theory is inherently quantum mechanical.
- The quantum version of this theory is readily achieved just by eliminating the high mass or short wavelength approximation on equation (3.9). It is outside the scope of this paper to implement hypergeometrical universe quantum algorithms. In a fully geometric theory, there are no energy or mass quanta. Motion is quantized by the QLP. All the other quantizations can be recovered from that.
- Two fundamental parameters of the universe were calculated from the first principles (permittivity and magnetic susceptibility of vacuum).
- Biot-Savart law was derived from the first principles.
- Grand unification supersymmetry conditions for the time when all forces were equal were derived from simple geometrical considerations.
- The fabric of space can be considered to be the regions of the hypersphere where the normal to its local space is pointing in the radial direction. Any region where that happens has a distinct and yet undistinguishable character. It is distinct because it is pointing in the direction of the universe expansion, but it is indistinguishable within the four-dimensional (relativistic) perspective. All reference frames are equivalent within a four-dimensional perspective. They become distinct but not distinguishable under a five-dimensional analysis.
- The natural frequency of spacetime oscillations is derived to be 32.14 KHz.
- Mach's non-local gravitational interaction explanation for inertia is replaced by a hypergeometrical local fabric of space distortion argument.
- Mach's and Newton's absolute times are assignable to the cosmological time. That time is absolute but can only be measured by observing the expansion of the four-dimensional hyperspherical universe.
- 3D and 4D masses were defined in terms of 3D projections of a 4D volume at specific phases of the hypergeometrical universe expansion 4D masses were the corresponding mass within a de Broglie expansion cycle
- Pseudo time-quantization was proposed.
- A fundamental dilator corresponding to both the proton and the electron was proposed. Particles were modeled as coherences between two 4D deformation states of a rotating 4D double potential well.
- Dilatons from the fundamental dilator were proposed to be light speed traveling metric modulations generated as the dilator tunnels from one state to the other, thus changing character from electron to proton and vice-versa. Anti-matter was proposed to be the same dilator just with a negative phase.
- Since all non-exotic matter (elements, electrons, neutrons, protons, anti-elements, anti-electrons, anti-neutrons and anti-protons) were proposed to be composed of the same dilator, a cosmological coherence is derived.
- Exotic matter (hyperons) is proposed to be the more complex coherences shown in Appendix A. Nuclear energy is proposed to be stored in deformations of the fabric of space resulting from mismatch of tunneling and tumbling processes within a complex coherence period. The mismatching would result in a tilted state at the de Broglie phases

of the Cosmological Coherence. It is proposed that interaction of these particles with the Universe through the QLP, requires that the beginning and final states to be flat on the 3D hypersurface and that any distortion to be distributed among sub-coherences. The amount of tilting on the individual sub-coherences is recovered at the moment of decay.

- Higher degrees of internal tilting can be achieved by non-fundamental sub-coherences. The higher the degree of internal tilting the lower the element or isotope lifetime.
- The only "force" is due to dilaton-dilator interactions subject to the quantum Lagrangian principle. There is no need for intermediating virtual particles to convey different forces.
- Particle decay, as opposed to collisional reactions, can be explained by nonlinear optics methods or standard barrier tunneling methods – quantum chemistry methodology. Of course, to create quantum chemistry methodology one has to have the Schrodinger equation for the 4D deformation rotating double well potential. This is outside the scope of this paper.
- There is a dilaton bath from which one can envision virtual dilators popping into existence, but it is not clear they are needed at all. Current science does not have the dilaton field, thus under those condition, virtual particles are need to explain nuclear chemistry. Notice that a dilator field is a matter field, that is, it is a function of the proximity of matter and not a property of empty space. It decays as one goes away from matter and thus it doesn't blow up as vacuum zero point fluctuations would. This is at the heart of the solution to the action-at-distance paradox. The photon decay is due to dephasing of the electronic coherence due to interaction with the dilaton black body field from the **detectors themselves**. Since the radiation arriving from the detector on the emitting molecule is polarized (by the polarizers), the outgoing photon will know its polarization at the moment of emission and not at the moment of interaction with the polarizers. **This eliminates the need of infinite velocity and thus eliminates the action-at-distance paradox**.
- The black body radiation due to dilators thermal fluctuations is not polarized and normally average to nothing. Thermal fluctuations are uncorrelated and isotropic. Any coherent motion will have a corresponding dilaton coherence along their 4D trajectory and a de Broglie projection in the 3D universe. This 3D de Broglie projection is real, that is, it is independent upon a single electron and at the same time it is dependent upon each and every electron in the coherent flow. The double slit experiment is done with a monochromatic flow of electrons passing through two slits. Due to the QLP, electrons will travel or surf the 4D dilaton field. That will have a 3D projection, which means that the electron will also surf the 3D projection of this dilaton field. We propose that the electron does not pass the two slits at the same time. It surfs a de Broglie dilaton projection that will create an interferometric pattern after the slits. Since the electron follows the dilaton field before and after the slits, it will follow the interferometric pattern and deposit accordingly. **Thus the electron in the double slit experiment does not need to pass through both slits at the same time**.
- Dilatons and standard collisional excitation should suffice in this theory. In the same way that electronic transitions can be created by collisions, dilator collisions can create 4D deformation transitions. These transitions, if accompanied with the creation of new coherences will interact with the existing universe otherwise they would just disappear. The appropriate description of the 4D deformational rotating double potential well and the dilator rotational dynamics will be described elsewhere.

- A refinement on the fundamental dilator model is to consider it a four-dimensional ellipsoid of revolution with a 3D projection of the 4D volume proportional to the particle mass and three axes' length quantum numbers equal to the corresponding quark composition. This is a zero 4D Volume sum rule for all the particles in the universe. Matter is energy and energy cannot be destroyed. 4D displacement volumes can! They have signs and any cosmogenesis theory basic on them will be able to **reduce the whole universe to a fluctuation of zero**. A simple hypergeometrical universe cosmogenesis theory will be presented in a companion paper
- Since quarks are modeled as quantum numbers (axis lengths) of a volume, they cannot be separated in the same way one cannot separate the X dimension from a three-dimensional object. Structured scattering, which has been used as an indication of the existence of quarks, can be easily understood as an indication of the existence of a form or shape, that is, particles are not spheres. Other dimensions of the standard model are modeled as rotations. Spin is modeled as a rotation perpendicular to radial direction and one spatial coordinate (x, y or z). Three/two additional dimensions are captured as rotational degrees of freedom for rotation along the three/two spatial axes.
- Matter and anti-matter should present anti-gravitational interaction, that is, they should repel each other with the corresponding gravitation strength.
- Planck's constant has a new meaning within this theory. It is the proportionality constant that ensures that the de Broglie wavelength, relating the observed 3D mass and 3D velocities, matches the 3D projection of the 4D dilaton. Notice that the 4D dilaton wavelength (frequency) depends only upon the gap between the two states of the fundamental dilator. This mapping is done through the linear momentum equation $h=m.v.\lambda$.

Cosmological Conclusions:

The hyperspherical expanding universe has profound cosmological implications:

- The expanding hypersphere clearly shows in geometrical terms that any position (cosmological angle) in the hypersurface (3-D universe) has a Hubble receding velocity.
- The HubbleVel, the Hubble cosmological expansion velocity at a cosmological angle θ (see Figure 1) is given by
    - $HubbleVel = c\theta$
    - This means that the three-dimensional space is expanding at the Hubble cosmological expansion velocity (speed of light per radian) as the hypersphere moves outwards along the radial time direction.
    - The corresponding elicited motions to all interactions in the universe are just side-drifts from a light-speed travel along the radial time direction. This explains why the speed of light is the limiting speed in our Universe. **It is the only velocity anything can move.**

Conclusions about Time

- This model contains one absolute time, the Cosmological Time and time projections for each inertial frame of reference.
- Although absolute, one cannot measure time using the Cosmological Time, unless one observes directly the Hyperspherical Expansion of The Universe.

- Our universe corresponds to the Xτ cross-section shown in figure 1. There one can only measure the relative angle between τ and τ', and thus only the relative passage of time.

Hence time can be both **Absolute** and **Relative** and both Einstein and Newton were right.

Astronomical Conclusions:

- The entire Universe is contained in a very thin three-dimensional hypersurface of a four-dimensional hypersphere of radius c*[Age of The Universe].
- The thickness of this hypersurface varies depending upon which dilator state is in phase with the 3D Universe. Electrons thickness is about 2000 times higher than the one for the proton.
- 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.
- The visible Universe volume is given by: $VisibleUniverseVolume = \frac{4\pi R^3}{3}$.
- The whole (Visible plus Invisible) Universe should have a volume of $UniverseVolume = \frac{4\pi(\pi R)^3}{3}$. The actual radius of the Universe is πR or around 47 billion light-years.
- Beyond the visible Universe lies the Never-to-be-Seen-Universe, whose linear dimension is actually (2π-2) times the dimensional time radius of the hypersphere. 3π/2R of the Universe linear dimension can never be reached
- 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.
- 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 τ. Under those circumstances the maximum velocity is always c.
- 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 absolute speeds faster than the speed of light.
- The highest absolute receding speed of this Universe is πc, which is the real speed bump in the whole Universe. Absolute receding speeds are measure with respect to the Cosmological Time Φ.
- Since the receding speed of the Big Bang is equal to the speed of light, all its electromagnetic 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.

- The Cosmic Microwave Background is likely to be Doppler Shifted Gamma Radiation and not Blackbody Equilibrium Radiation.
- 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. 16.4 Billion years, 55 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.
- 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).
- 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.
- Due to the topology of a four-dimensional Big Bang, the center of the Universe is a location in the radial direction and not in 3D space.
- Unlike motions along other directions of the four dimensional space, travel along the radial time occurs only at the speed of light.
- 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.
- 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.
- 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).
- 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. 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 can only reach the future when it is the present, since we are traveling there even as we speak.
- Beyond the Big Bang lies more of the same (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.

- 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 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 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.
- 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 proper 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.
- Appendix B 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

- The meaning of physical existence is being phase-matched along the radial direction.
- Appendix B 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.
- 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 (see DeltaPlus and SigmaPlus hyperons in Appendix A). From this description it becomes evident that antimatter should produce anti-gravity. This is supported by the grand unification equations presented in section 3.
- Appendix A indicates that the conversion of matter to antimatter is done through half-neutrinos interaction with matter. Cross-section for neutrino splitting might be low, thus explaining why there is an asymmetry in the proportions of matter and antimatter in the Universe.
- 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.

- 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.

Fundamental Conclusion:

A last conclusion worth mentioning is a modification of Newton's first law:
In the absence of interactions, a body (locally deformed FS region) will drift within the hypersurface (3-D universe) until τ and R are parallel again or conversely until it reaches a point where its drift velocity equals the Hubble velocity of that region of space.

Notice that the apparent motion will still exist since the fabric of space is expanding and any place in the 3D universe has a Hubble expansion velocity. Although moving relatively to its original position, the body remains static with respect to the fabric of space (τ parallel to R). At that point, the local deformation ceases to exist and the body drifts with the expansion at the Hubble velocity. In other words, motion is a way for 4D space to relax; in the same way a tsunami is the means for the sea to regain a common level.

Appendix A- Hypergeometrical Standard Model

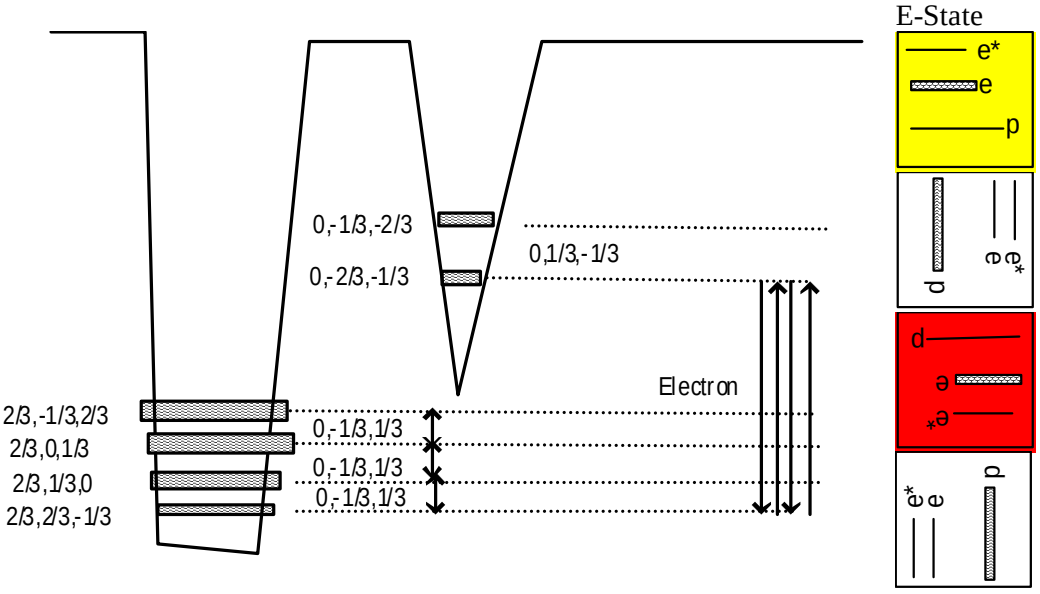
Here is a brief description of the Hypergeometrical Standard Model. A full description will be published elsewhere.

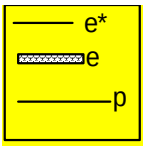
The Fundamental Dilator is modeled as a coherence between two 4D deformational stationary states of a double potential.

The quantum numbers, associated with the 4D deformational states, are modeled as axes' lengths of a 4D ellipsoid of revolution. Negative values correspond to 180 degrees in phase with respect to a dilator with a positive axis. This means that when the positive dilator is expanding the 4D space, the negative dilator is shrinking 4D space.

Below is a diagram showing the states involved with the fundamental dilator.

Electron Model



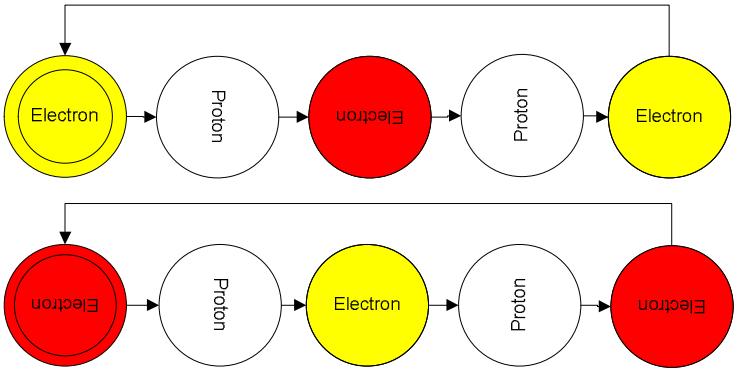


Where p=(2/3,2/3,-1/3),e=(0,-2/3,-1/3),e*=(0,-1/3,-2/3) are a subset of states involved in the three most common "particles"= proton, electron and neutron. Below is another representation of the electron and positron. Notice that the first and last elements of the coherence chain are the same and that the coherence repeats itself for its lifetime. In the case of a proton/electron, that lifetime is infinite, since that coherence is between two ground states.

This is an effort to represent a tumbling 4D object which changes shape as it tumbles. Notice that the sidewise states have no 3D projection. Since in the theory, there is an absolute time, one can define an absolute phase and that is what distinguishes an electron from a positron. Later it will be clear that more complex coherences involving the e* state (neutrino) will result in a phase shift of the tunneling process with respect to the tumbling process, thus modifying which state is in phase with the shock-wave universe.

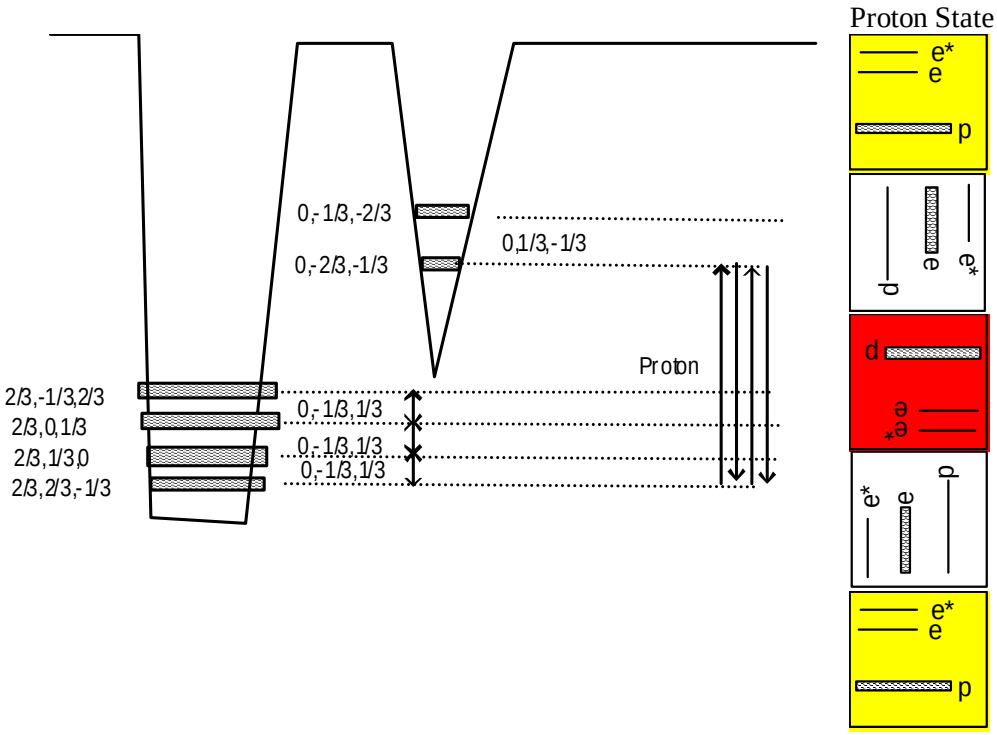
The colors are shown only for states that have both a 3D projection and the same frequency as the fundamental dilator.

Another important element of the model is the bolden of the first axis length (e.g. p=(2/3,2/3,-1/3)). This means that the spin is a tumbling process around and rotational axis perpendicular to both the radial direction (perpendicular to all three spatial coordinates and the x coordinate). This defines a 4D angular momentum which has to be conserved. More complex coherences like the ones associated with Delta and Sigma particles differs just by the final spin and thus by how the sub-coherences tumbles to make up the final amount of spinning.

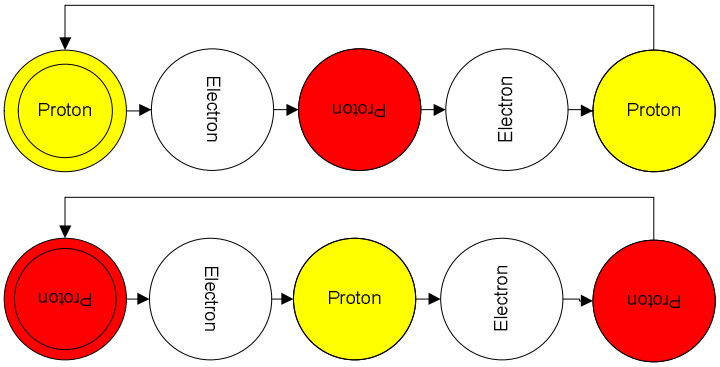


Proton Model

Similarly for a proton:

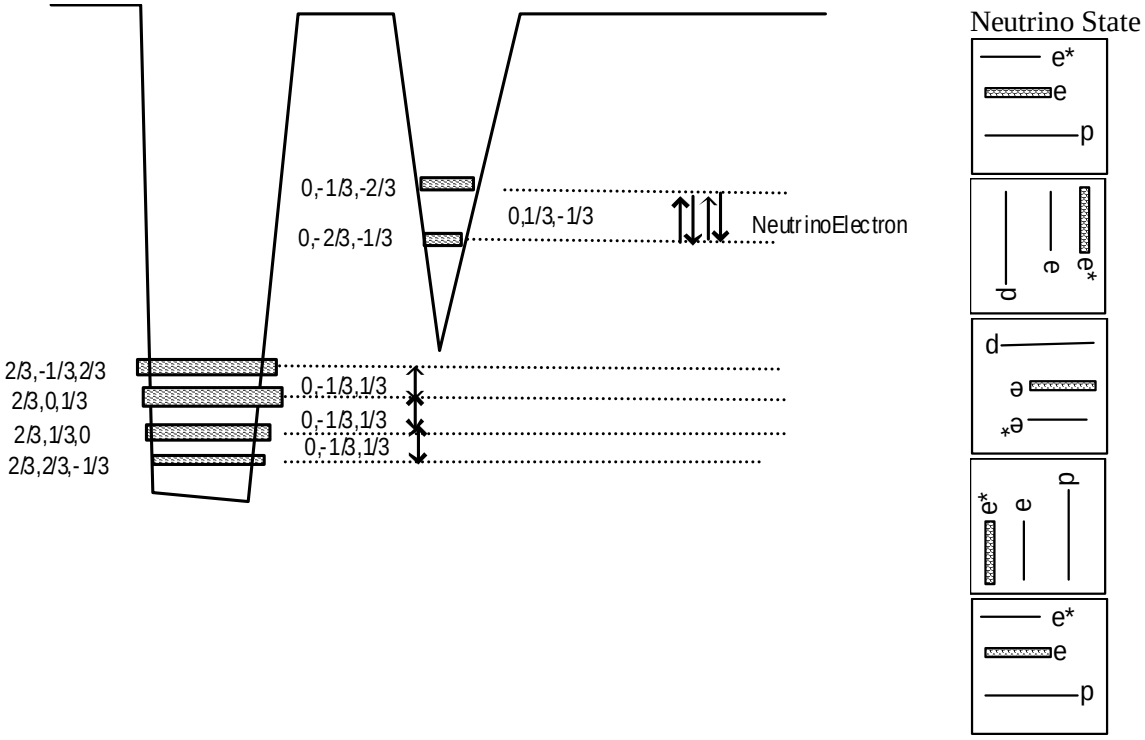


Here is the representation of a proton and an antiproton.



NeutrinoElectron Model

Here is the electron neutrino model. Notice that there are no color associated with the neutrino states since they have zero 3D volume (they are 2D objects spinning around the a

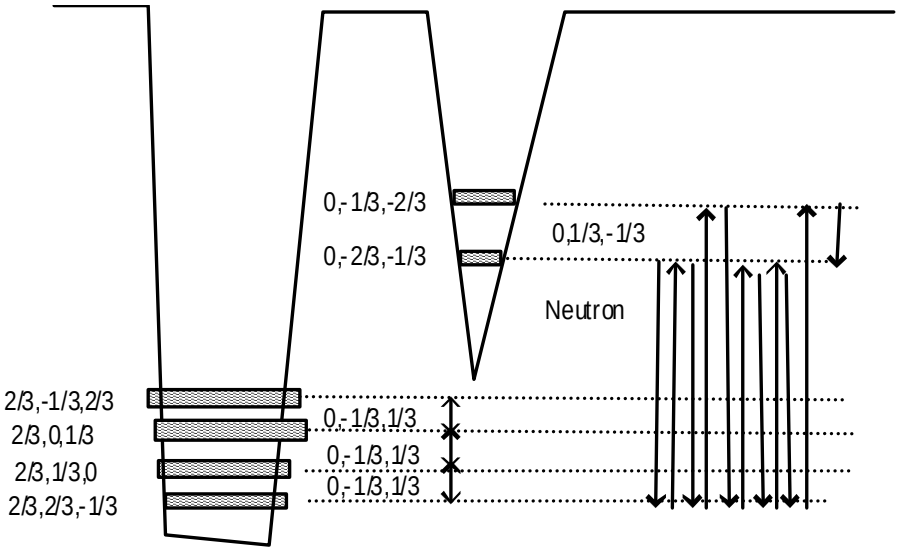


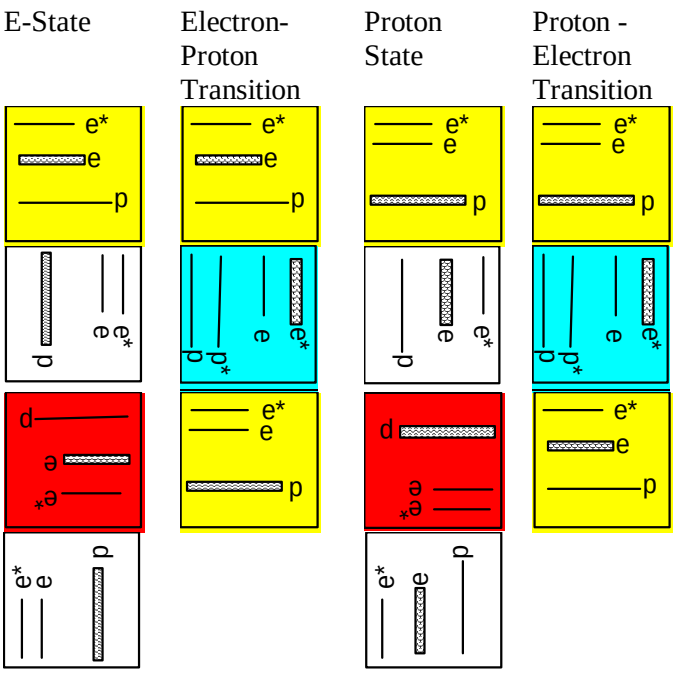
Where p=(2/3,2/3,-1/3),p*=(2/3,-1/3,2/3),e=(0,-2/3,-1/3),e*=(0,-1/3,-2/3)

Neutron Model

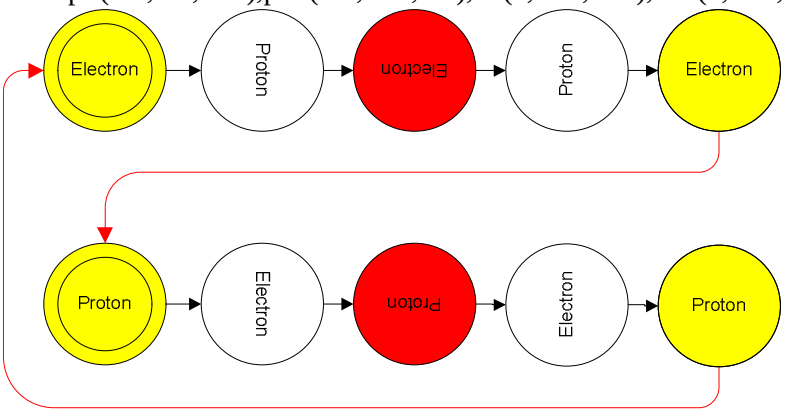
Below is the Neutron model. It is worthwhile to notice that the Electron-Proton and Proton-Electron transitions (transmutation coherences) are not in phase with the tumbling process and thus lead to a mismatch between the Neutron overall tumbling and a number of full rotations. This means that due to those sub-coherences, there is kinetic energy stored in the form of a local fabric of space twisting. The angle error at the end of the coherence is the sum of those two contributions. The electron and the proton coherences are by definition in phase with the tumbling process.

The shift in phase is such that the electron/proton fabric of space twisting is 42.77/-0.07294 degrees for a neutron at rest, respectively. This is the fabric of space twisting that would result in the observed relative velocities after neutron decaying. Notice that twisting the fabric of space results in an increase in the mass or 3D projection of the 4D volume displacement associated with different states, and thus explains the extra mass involved in the neutron formation. The same reasoning is applicable to all particles and elements. The elements and isotopes are modeled as simple coherences involving only the fundamental dilator (electron and proton) and these two transmutation coherences.



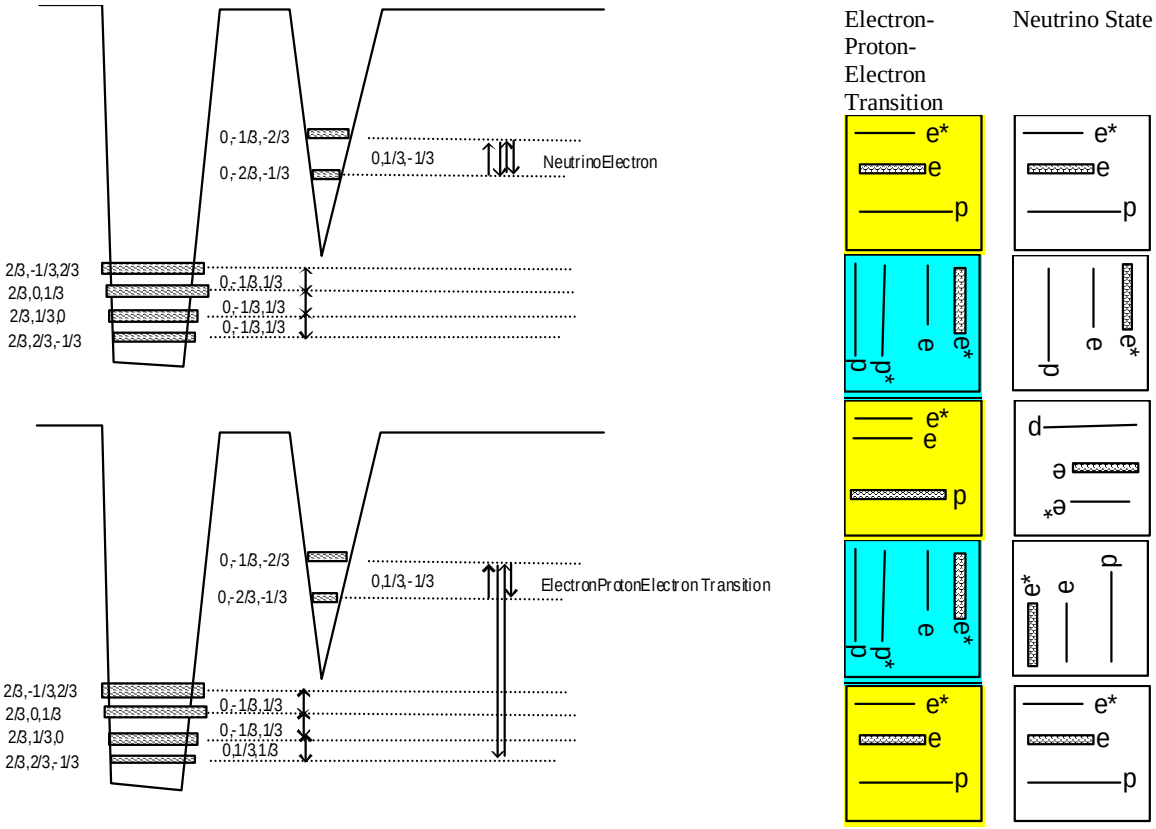


Where p=(2/3,2/3,-1/3),p*=(2/3,-1/3,2/3),e=(0,-2/3,-1/3),e*=(0,-1/3,-2/3).



The extra energy or mass associated with the neutron is due to the dephasing created by the Electron-Proton Transition and vice-versa. The total angle is balanced between the two 3D footprints (electron and proton masses) to be 42.77/-0.07294 degrees, thus resulting in a dephasing angle by Electron-Proton Transmutation of around 21.4 degrees.

Thus the available kinetic energy after neutron decay is the difference in twisting between these two coherences.



Spin Differences between Hyperons

The hyperons[9] below differs only by the spinning direction of their sub-coherences[7].

Hyperon Name	**Symbol**	Mass (MeV/c^2)	**Decay Process**	Spin	Coherence Lifetime	Coherence Decomposition
DeltaPlus	$\mathbf{\Delta^+}$	1232	$\boldsymbol{\pi^+}$ + **n**	3/2	6×10^{-24}	(**0**,2/3,1/3). (**0**,-1/3,1/3). (**2/3**,2/3,-1/3). (**0**,-2/3,-1/3).
DeltaPlus	$\mathbf{\Delta^+}$	1232	$\boldsymbol{\pi^0}$ + **p**	3/2	6×10^{-24}	(**0**,-1/3,1/3) (**2/3**,2/3,-1/3) .(**0**,1/3,2/3) .
DeltaZero	$\mathbf{\Delta^0}$	1232	$\boldsymbol{\pi^0}$ + **n**	3/2	6×10^{-24}	(**0**,-1/3,-2/3) (**2/3**,2/3,-1/3). (**0**,-2/3,-1/3). (**0**,-1/3,1/3). (**0**,1/3,2/3) .
DeltaZero	$\mathbf{\Delta^0}$	1232	$\boldsymbol{\pi^-}$ + **p**	3/2	6×10^{-24}	(**0**,-1/3,-2/3) (**0**,-2/3,-1/3). (**0**,1/3,-1/3).
DeltaMinus	$\mathbf{\Delta^-}$	1232	$\boldsymbol{\pi^-}$ + **n**	3/2	6×10^{-24}	(**2/3**,2/3,-1/3) (**0**,-2/3,-1/3). (**0**,1/3,-1/3). (**2/3**,2/3,-1/3). (**0**,-2/3,-1/3).
LambdaZero	$\mathbf{\Lambda^0}$	1115.7	$\boldsymbol{\pi^-}$ + **p**	1/2	2.60×10^{-10}	(**0**,-1/3,1/3) (**0**,-2/3,-1/3).

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LambdaZero	$\mathbf{\Lambda^0}$	1115.7	$\boldsymbol{\pi^o}$ + **n**	1/2	2.60×10^{-10}	(**0,**1/3,-1/3). (**2/3**,2/3,-1/3) (**0**,1/3,2/3) . (**0**,-1/3,-2/3). (**2/3**,2/3,-1/3). (**0**,-2/3,-1/3). (**0**,-1/3,1/3)
SigmaPlus	$\mathbf{\Sigma^+}$	1189.4	$\boldsymbol{\pi^0}$ + **p**	1/2	0.8×10^{-10}	(**2/3**,2/3,-1/3). (**0**,1/3,2/3). (**0**,-1/3,-2/3)
SigmaPlus	$\mathbf{\Sigma^+}$	1189.4	$\boldsymbol{\pi^+}$ + **n**	1/2	0.8×10^{-10}	(**2/3**,2/3,-1/3). (**0**,-2/3,-1/3). (**0**,-1/3,1/3). (**0**,2/3,1/3). (**0**,-1/3,1/3)

This means that in the case of Δ^+, four sub-coherences are tumbling in one direction while the one left is tumbling in the opposite direction. Since each sub-coherence has spin half angular momentum, the resulting spin is 3/2.

In the case of the $\mathbf{\Sigma^+}$, three sub-coherences tumble in one direction and two sub-coherences tumble on the opposite direction, resulting in spin ½. One expects that the amount of strain on the fabric of space will correlate with the coherence lifetime or life of the particle and thus that $\mathbf{\Sigma^+}$ would have a lower amount of accumulated dephasing with the fundamental dilator tumbling than $\mathbf{\Delta^+}$.

Hyperon Name	**Symbol**	Mass (MeV/c^2)	**Decay Process**	Spin	Coherence Lifetime	Coherence Decomposition
DeltaPlus	$\mathbf{\Delta^+}$	1232	$\boldsymbol{\pi^+}$ + **n**	3/2	6×10^{-24}	(**0**,2/3,1/3). (**0**,-1/3,1/3). (**2/3**,2/3,-1/3). (**0**,-2/3,-1/3). (**0**,-1/3,1/3)
SigmaPlus	$\mathbf{\Sigma^+}$	1189.4	$\boldsymbol{\pi^+}$ + **n**	1/2	0.8×10^{-10}	(**2/3**,2/3,-1/3). (**0**,-2/3,-1/3). (**0**,-1/3,1/3). (**0**,2/3,1/3). (**0**,-1/3,1/3)

Appendix B- HU Corrections to Relativity

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

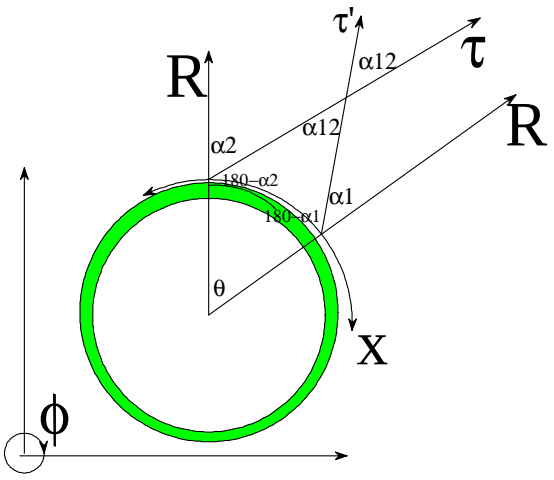

Figure B1. Hyperspherical Universe Model displaying two reference frames.

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 $\theta=\pi/2$. This means that two traveling parties departing up to a cosmological angle $\theta=\pi/2$, 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:

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

Or

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

Relativity fails for cosmological distances. It is worth emphasizing that for $\tan(\theta)=1$ ($\theta=45^o$), independently upon the local velocities v_1 and v_2, the perceived velocity v_{12} is always -c.

$$v_{12} = \frac{v_1 + v_2 - c(1 + \frac{v_1 v_2}{c^2})}{1 + \frac{v_1 v_2}{c^2} - \frac{1}{c}(v_1 + v_2)} = -c$$

Thus for $\theta=45^o$, 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 proposed to be the pervasive Cosmic Microwave Background.

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