The Case for a Fourth Spatial Dimension and the Hyperspherical Force

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ABSTRACT

Here we present evidence of an extra spatial dimension and that our 3D Universe is embedded as a lightspeed expanding hyperspherical hypersurface. Support for this hypothesis comes from (a) SDSS-BOSS dataset analysis showing the seeding of Galaxies on the largest scale by spherical acoustic oscillations, (b) the discovery of an Hyperspherical Force, a constraint force that exists only because of the lightspeed hyperspherical expansion. That solves the Spiral Galaxy Rotation Conundrum, (c) the parameterless predictions of all type 1a Supernovae (SN1a) distances from their redshifts z. Lightspeed hyperspherical expansion permits simple short-distance compliance with the Hubble Law.

Keywords: topology, cosmology, general relativity, L-CDM, extra dimension, 4D

INTRODUCTION

The way Physics can “prove” the existence of an extra spatial dimension is by observing things that can only happen in a space that has extra dimensions. Physics can also support an argument by showing that its implications solves conundrums with a simpler explanation. The strength of this argument relies on Occam’s Razor Principle. This is concept used in ‘dynamics programming’. The basic idea is that if you always choose the simplest
theory that explains everything, you will be closer to a Fundamental Theory (a predictive theory) at the end. Current theories (e.g. L-CDM, General Relativity) are Fitting Theories. In the case of L-CDM, the Standard Model of Cosmology, the parametrization is showcased in this Hubble Function [1–3]:

\[ H(a) = \frac{\dot{a}}{a} = H_0 \sqrt{(\Omega_m + \Omega_b) a^{-3} + \Omega_m a^{-1} + \Omega_k a^{-2} + \Omega_{DE} a^{-3(1+w)}} \]  

(1)

This showcases where Dark Matter and Dark Energy comes from within the scope of Cosmology. They are fitting parameters in this function.

In section 1, we will present the SDSS BOSS [4,5] evidence obtained through the creation of a 3D Relief Map (3D Galaxy Density Map) of the Current Universe.

Fig. 1 presents the cross-sections of this lightspeed expanding hypersurface:

![Peering into the Past](image)

**Figure 1.** Here we show us at position A, looking at a type 1a Supernovae (SN1a) at position C when the Universe was 8 Billion Years old and the radius of the Universe was 8 Billion Light Years. Notice the wavefronts in this 4D Space. Since we live in the hypersurface (approximated by a hyperplane in our closer neighborhood), we only see the intersections of those wavefronts onto the hyperplane. It is clear the geometric nature of redshifting from this image.
For that we used the SDSS BOSS Survey datasets and the Hypergeometrical Universe Theory [6] (HU) Cosmological Ruler \(d(z)\) and the model for inertial motion within the Hyperspherical Expansion to predict where all 1.3 million galaxies would be in the Current Universe. That said, the mapping used is not paramount to the analysis process. Any mapping would yield the same spherical galaxy density distribution and clustered galaxy distribution lines. Only the scales would change, if another mapping were used. This is possible because of the Hypergeometrical Universe Theory (HU) [6] that includes in its hypotheses the very same concept that the Universe is the lightspeed expanding hyperspherical hypersurface. So, evidence provided here further reinforces the predictability of HU theory.

To create the map, HU derives from first principles, the following Cosmological Ruler \(d(z)\). This function yields distance as a function of redshift. The Cosmological Angle \(\alpha\) is given by:

\[
\alpha = \frac{\pi}{4} - \arcsin \left( \frac{1}{\sqrt{2(z+1)}} \right)
\]

While the distance is given by:

\[
d = d_{\text{HU, epoch}} = R_0 \left( 1 - \cos(\alpha) + \sin(\alpha) \right) = R_0 \frac{z}{(1+z)}
\]

In Section 2, we examine the Galaxy Rotation Curve Conundrum. The conundrum is due to the faster than expected star and Hydrogen gas velocities as we move farther and farther from the center of the Galaxy:

![Figure 2. Rotation curve of spiral galaxy M 33 (yellow and blue points with error bars), and a predicted one from distribution of the visible matter (white line). The discrepancy between the](image)

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This conundrum occurs because the velocity profile of stars and gas clouds in the outermost regions of spiral galaxies do not obey Newtonian Dynamics. Farther from the center of mass of the galaxy, stars and hydrogen clouds are expected to rotate slower and slower, otherwise their centrifugal force would allow them to escape the galaxy gravitational domain.

To address this conundrum, Mordehai Milgrom [10] proposed a modification of Newtonian Dynamics. The proposal was based on ad hoc straight modification of Newton’s Law of Gravitation. Alternatively, the Current Standard Model of Cosmological L-CDM proposes the existence of a Halo of Dark Matter that keeps matter from flying apart.

Here we will show that the lightspeed expanding hyperspherical topology provides a new constraint force, the \textbf{Hyperspherical Force} and that solves the Spiral Galaxy Rotation Velocity Conundrum.

In section 3, we will show that consistently with all evidence that the Universe is a lightspeed expanding hypersphere, all type 1a Supernova distances are predicted from first principles.

HU derives from first principles a new Law of Gravitation that is both epoch- and velocity-dependent.

\begin{equation}
F_{\text{Gravitational}} = \left[ \frac{N}{\chi} \right] \frac{\lambda c^2 \lambda_1}{(2\pi)^3 R_0^3} \frac{1}{\xi} \left( \frac{1}{c} \right) \left( \frac{1 - \tan^2(\alpha_0 + \alpha_\tau)}{\left(1 + \frac{V_1 \cdot \hat{R} - V_2 \cdot \hat{R}}{c^2} + \frac{1}{2} \frac{V_1 \cdot V_2}{c^2} \right)} \right) \frac{\hat{R}}{(1 + \frac{V_2 \cdot \hat{R}}{c}) \Delta R^2}
\end{equation}

Or written in terms of dimensionalized Cosmological Time $\Phi$. \textbf{This is the correct version to be used on Cosmological Distances.}

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\end{equation}

The epoch-dependence comes through the Gravitational Constant $G$. Notice that it is not a Constant anymore. It has a 4D radius $R_0$ dependence on the denominator. This means that earlier epochs (larger distances) had stronger Gravitation. HU derives the Supernovae Absolute Luminosity $G$-dependence to be $G^{-3}$ and that would mean that all photometrically derived distances (using the Stellar Candle or constant Absolute Luminosity hypothesis) had a bias of $G^3$. Since farther away SN1a have smaller Absolute Luminosity, they seem farther than they really are. Needless to say, that eliminates the need for Dark Matter and Dark Energy, which is convenient since the introduction of an extra spatial dimension and the
symmetry of the hyperspherical topology rules out any relevance of the mass content of the Universe on its dynamics. This means that the introduction of an extra spatial dimension and hyperspherical topology indicates a rebuttal to General Relativity, the Standard Model of Cosmology L-CDM, the Big Bang, Singularity Physics and consequently the Higgs Mechanism for mass creation.

Section 1. SDSS BOSS Survey Evidence

The SDSS (Sloan Digital Sky Survey) is a robotic telescope that has been collecting data on 1.3 million galaxies.

The SDSS BOSS dataset has been reviewed in several articles. We were able to study the data in a different way. First, HU is a 5D Dynamic (speed of light) Spacetime Theory. The extra dimension permits the use of the local deformation of the Fabric of Space as an indicator of Absolute Velocity. Absolute Velocity and Time can be seen if one steps out of the 3D Hypersurface. HU recast Newton’s Laws in terms of the torsional state of the local Fabric of Space. HU explains the Newton’s First Law raison d’être using this diagram:

![Diagram showing particle traveling inertially with tangential velocity](image)

**Figure 3.** Here we show a particle traveling inertially with a tangential velocity given by \( \tan(\alpha_1) = \frac{v}{c} \), where the angle is taken with respect to the radial direction. Later, as the Hyperspherical Universe expands, that same angle will be \( \alpha_2 \), a smaller angle. This was used to support the assertion that inertial motion occurs to relax the Fabric of Space (FS). Conversely, after billions of years, matter in the Universe will coalesce around relaxed FS. At that point motion will only occur radially and be seem as Hubble Flow. A relaxed FS has its normal pointing along the radial direction.
From this diagram, it becomes clear that once a galaxy is determined to be at a given distance (epoch), the projection of that image into the present requires only having a distance on the outermost circle (see Fig. 1) along the radial line, thus at position d. Since the radius of the Universe is normalized at the current radius (13.58 Billion Light Years), the numerical value of d is equal to the angle alpha in radians. This was used in the creation of the Map of the Current Universe.

SDSS collects many parameters describing each galaxy. The ones I used in my analysis are:

1. Angular positioning angles (Declination and Right Ascension).
2. Redshift z
3. Number Density (NZ). This serves as a proxy to mass or luminosity

The data analysis comprises:

1. Calculate d(z) for all 1.3 million objects
2. Calculate angle alpha and map that to the distance d on the Current Hypersphere. This is the distance from us, of the object. Since we know Declination and Right Ascension and since Hubble Flow doesn’t change them, we know where the object will be in the Current Universe.
3. Bin space and aggregate points multiplied by Number Density per bin. That is a proxy for Galaxy Density or Mass Density.

That is simple but other theories are constrained by a 4D Spacetime and have no concept of Absolute Time, Absolute Reference Frame, so they cannot do this simple analysis. Below is the resulting 3D Galaxy Density Map for the Current Universe obtained using HU Cosmological Rule

**Figure 4.** This shows a white ring, actually an spherical region of higher density of galaxies, consistent with the seeding being done by Spherical Acoustic Oscillations.
Below is the cross-section of this 3D map, showing further evidence of galaxy seeding by acoustic oscillations. The number of recurrences (36) indicates that that happened during the first 3012 years of the Universe existence. [6]

To create the clustering with 1.3 million data points, I first aggregated in one angle and the plotted all data irrespective of the other angle information. Since we have two angles and two datasets, that leads to four panels. Clustering is easily done by eyeball, since the galaxy densities grouped themselves along lines that can be mapped to recurrences of the spherical acoustic mode.

**Figure 5.** SDSS BOSS dataset cover North and South regions of the Sky and can be cut both along the Declination or the Right Ascension. The protocol for the creation of these plots is to aggregate along one angular coordinate and then plot all data irrespective of the remaining angular coordinate for each value of distance. This allows for the clustering of all galaxy densities into these lines. Distance is normalized with respect to the 4D radius of the Universe (13.58 Billion Light Years, which corresponds to $H_0 = 72$ km/s/mpc).
36 Rings

Below you can see details indicating the 36 rings:

Figure 6. HU proposes that these hyperspherical acoustic oscillations recurrences took place during the first 3012 years of Neutronium Phase of the Hyperspherical Universe. During that time, the Universe was proposed to be a lightspeed expanding Black Hole density (Blackholium). As expansion occurred, the density diminished and it became a Neutronium (Neutron Star density lightspeed expanding hyperspherical hypersurface). The energy to drive the oscillations came from Neutron evaporation and decay. Gravity/Electromagnetism played no role because of symmetry. HU explains lightspeed expansion in terms of Entropic Explosion (similar to the Prince Rupert Drop).

Notice that the Universe started with Zero Entropy (Zero Kelvin Blackholium with no degrees of freedom), thus HU obeys all Laws of Physics and the 2nd Law of Thermodynamics. Since spherical acoustic oscillations are not allowed to resonate in a boundless 3D space, we conclude that space cannot be a simple 3D Spatial Manifold. We propose it to be a light speed expanding hyperspherical hypersurface since that is consistent with the Hubble expansion, and the spherical acoustic mode. Later, it will become clear that the remaining arguments will further support this conclusion.

Section 2. Predictions of Type 1a Supernovae (SN1a) Distances

In the introduction, we explained that HU derived a New Law of Gravitation that is epoch-dependent and velocity-dependent. This Law of Gravitation was shown to pass General Relativity tests (Gravitational Lensing and Mercury Perihelion Precession rate). Now we show that it passes three tests that GR and L-CDM failed:
1. Parameterless Prediction of all SN1a distances
2. Compliance with the extra spatial dimension and lightspeed expanding hyperspherical topology. HU topology would produce spherical acoustic modes within the hypersphere.
3. Parameterless Predictions of Spiral Galaxy Rotation Curves (presented in Section 3).

Below are the parameterless predictions of SN1a Distances:

**Figure 7.** HU predictions of SN1a distances (Union 2.1 Supernovae Survey). These are parameterless predictions using the lightspeed expanding hyperspherical topology and thus they do not require Dark Matter nor Dark Energy and are compliant with the SDSS BOSS survey observations.

**Section 3. Predictions of Spiral Galaxy Rotation Curves**

**Figure 8.** This shows vectors $v_1$ and $v_2$ and Cosmological Angles $\alpha_1$ and $\alpha_2$ for a de Broglie step of the Universe expansion. HU recast Newtonian Dynamics in terms of Space Strain-Stress paradigm. A change in angle maps to an acceleration since a constant angle of propagation maps to in inertial motion.
Hyperspherical Force

This is a constraint force, it only exists because of the expansion of the Universe. Notice the change in direction of the vector \( v \) just due to the expansion. If you sit on a Star, rotating around a galaxy center, as time goes by, the hyperspherical hypersurface becomes flatter and that makes my velocity to increase towards the center of the galaxy. This means that there is a hidden acceleration which I am claiming to be due to this Hyperspherical Force.

Modeling it is trivial:

\[
\alpha_1 = \frac{d}{R_0} \quad (6)
\]

\[
\alpha_2 = \frac{d - \lambda_1 v}{R_0} \quad (7)
\]

\[
v_1 = \alpha_1 - \frac{v}{c} \quad (8)
\]

\[
v_2 = \alpha_2 - \frac{v}{c} \quad (9)
\]

\[
\frac{dv}{d\lambda} = \frac{d\alpha}{d\lambda} = -\frac{\alpha_2 - \alpha_1}{\lambda_1} = \frac{v}{R_0 c} \quad (10)
\]

\[
\frac{d\tan(\alpha)}{d\lambda} = \frac{d\alpha}{d\lambda} = -\frac{\alpha_2 - \alpha_1}{\lambda_1} = \frac{v}{R_0 c} \quad (11)
\]

\[
a = c^2 \frac{d\tan(\alpha)}{d\lambda} = \frac{cv}{R_0} \quad (12)
\]

Total Acceleration = \(-\frac{GM}{d^2} + \frac{cv}{R_0} + \frac{v^2}{d}\) = 0 \quad (13)

Where you can recognize all the terms: Newtonian Gravitational, the Hyperspherical and Centrifugal Forces. Hence:

\[
v = \frac{cd}{R_0} + \sqrt{\left(\frac{cd}{R_0}\right)^2 + \frac{GM}{d}} \quad (14)
\]

Here is the application of this model to the M33 Spiral Galaxy. M33 contains 5E10 Sun Masses as measured by the Stars aggregated Luminosity. The mass distribution was modeled simply by:
\[ \text{Mass}(d) = \frac{M_0}{\left( \frac{d}{r_s} \right)^a \left( 1 + \left( \frac{d}{r_s} \right)^b \right)^5} \]

(15)

Where these are the optimized parameters:

\[ \text{Mass}(d) = \frac{M_0}{\left( \frac{d}{r_s} \right)^{-2.79} \left( 1 + \left( \frac{d}{r_s} \right)^{0.5} \right)^{4.4}} \]

with

ScaleRadius = \( r_s = 7.25 \times 10^6 \) light-years

\( M_0 = 7.07 \times 10^{10} \) Sun masses

(16)

None of the discrepancies are significant since the exact numbers depend upon the distribution shape. In the calculation of density, we used a spherically homogeneous distribution.

**Predicted M33 Rotation Curve**

Below is the resulting mass distribution and corresponding velocities, which is consistent with a homogeneous, centrally distribution of mass and gases:

![M33 Galaxy Rotation Curves](image)

**Figure 9.** M33 Galaxy optimum mass distribution, observed rotation velocity curve and HU prediction.
This means that Hypergeometrical Celestial Dynamics easily replicate observations with reasonable mass distributions, using a variation of Navarro–Frenk–White profile. This mass profile is consistent with N-body simulations that lacks the Hypergeometrical Force, so it had to be modified.

**The Shape of Small Spaces**

HU models motion as the result of torsion on the local Fabric of Space. That happens in a very localized manner. HU models matter as polymers of the Fundamental Dilator, a coherence between stationary states of deformation of the local metric. This means that they are shapeshifting, spinning in 4D, deformations of space. When speaking of torsion of the Fabric of Space in relation to a body or atom, one is referring to the footprints of these dilators.

**DISCUSSION**

The SDSS BOSS data is quite clear with respect to galaxies been seeded by spherical acoustic oscillations. Some might argue that we could add momentarily reflective spherical boundary conditions in a 3D Spatial Manifold, an Universe Wall, if you will. I would argue that that is going against Occam’s Razor.

Adding to that, HU explains everything that is currently explained with unsupported quantities (Dark Matter and Dark Energy) just using a simple topology change.

No observation says anything about inertia for traveling along the radial direction and thus there is no infringement of any Laws of Physics in having the Whole Universe traveling at the speed of light perpendicular to itself. The proposed model for matter is used to explain the Universe was propelled by a mechanism identical to the Entropy Explosion in the Prince Rupert Drop [6,11].

**CONCLUSIONS**

Astronomical observations ranging from the SDSS BOSS Survey, Galaxy Rotation Curves and the type 1a Supernovae Cosmological Ruler all support the lightspeed expanding hyperspherical hypersurface topology.

Not only that, the observation of Galaxy Seeding by Spherical Acoustic Oscillations refutes the current view that the Universe is a simple 3D Spatial Manifold or that we live in a 4D Spacetime.

Clustering details of the galaxy seeding indicates that not only the topology is hyperspherical, but also that the oscillations started small and grew larger with time. This is consistent again with HU proposed Big Pop and Many Bangs Cosmogenesis [6]. This also refutes the Big Bang and Singularity Physics as means to create this Universe.

The Hyperspherical Topology and HU provides a simple explanation to the Spiral Galaxy Rotation Curve Conundrum by revealing a **New Force of Nature – The Hypergeometrical Force**. This is a constraint force due to the continuous changes in Space curvature. The Hyperspherical Topology and HU provides a new Law of Gravitation, a new mechanism for redshifting and a new Cosmological Ruler derivation from first principles. HU
demonstrate the Absolute Luminosities would change with G and that would make Type 1a Supernovae not behave as Stellar Candles. Once corrected the bias, HU predicted all SN1a Supernovae distances from their redshifts \( z \) and did so without a single parameter.

Evidence provided here refutes General Relativity, the Standard Model of Cosmology L-CDM, Dark Matter and Dark Energy, the Big Bang theory, the Initial Singularity and the Higgs Mechanism for Mass Creation since it requires high temperatures and pressures. Evidence is that the Universe started at Zero Kelvin (due to lack of degrees of freedom) as a Blackholium.

References