Universal Gravity and the Texture of Spacetime:

Updates and Mathematical Constructs

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May 24, 2014

Abstract: *Feedback obtained from the scientific community regarding the hypotheses presented in* *Universal Gravity and the Texture of Spacetime - Tasman 2013* *(which was based on employing a consistency of valid metaphors and applying Occam's Razor) indicates that credentialed cosmologists are reluctant to take a novel idea without provide a mathematical foundation or model for the ideas presented. There was clear support for exploring the possibilities based on the experimentation that was suggested in the above-referenced manuscript, but that alone would not be sufficient. This manuscript is intended to provide clarifications on points raised by well-known cosmologists in the review of that manuscript as well as to provide enough of a mathematics foundation so that credentialed cosmologists dedicated to the field of study can launch a new platform and approach in the exploration of alternative theories to Dark Energy and Dark Matter to explain celestial body dynamics.*

Background

This manuscript furthers the hypotheses presented in *Universal Gravity and the Texture of Spacetime: A plausible hypothesis for observations about celestial body dynamics, Tasman, 2013* by converting a metaphorical discussion into a mathematical discussion along with structure for a working model that lends true physical meaning to the hypotheses presented in the above manuscript. My motivation for doing so is threefold:

1. Based on feedback from scientists who have reviewed and responded to my first manuscript[1], I have learned that any point of view is better situated when supported by hard math. While I clearly stated in my first manuscript that the intent was to generate thought-provoking ideas that other more credentialized scientific professionals could pursue further, it seems the idea alone in not enough. Additionally, I found that I have to provide additional explanations for my points of view to counter specific challenges to my analysis on the basis of assumptions and definitions, most importantly around treatment of extrinsic vs. intrinsic curvature.

2. My own observations about the scientific community and study involving theoretical physics is that two main camps emerge anytime new ideas are presented – one camp that supports model development based on mathematical constructs and another camp devoted to testing models and theories by applying them to existing data-sets or through new experimentation. In both cases, the demand is hard data and math. Metaphors and philosophical approaches that appeal

[1] Viktor Toth (2014), Michael Tamir (2014)

to logic seem to have no place in the scientific community (which I think is a shame). Given that we are dealing with a new idea and novel set of constructs, ultimately then we need to get to a model that scientists can build on. (I recognize that in my first manuscript, my hypotheses were nothing more than novel ideas presented with enough logic to spur interest in further study.)

3. The granularity afforded by the mathematical discussion lends further support to the ideas presented because they enhance the options for exploration and next steps. (In the first manuscript I challenged the scientific community to test my ideas through achievable experimentation involving celestial body observations. That opportunity is still there for anyone who wants to test it. Now with a mathematical construct to serve as a model for my hypotheses, scientists can have the additional option to further flesh out the model components and steps that I present below.)

It is important to reiterate that in my prior manuscript, my discussion was always in reference to a metaphor that uses a rubber sheet analogy for gravity wells that I knew both then and now is not the same thing as a Riemannian manifold modeled by a metric tensor (specifically cited by Tasman, 2013: *"Gravity Wells and the Rubber Sheet model are for explanatory purposes only and distinct from the general relativistic embedding diagrams such as Flamm's paraboloid in describing Einstein's relativistic motion and the curvature of spacetime which cannot be physically revealed (including motion through time) in three dimensions."*).

Instead, the motivation then was to show consistency in applying a metaphor that works on a universal scale. One important piece of feedback that I received using that approach was that I had not properly respected the background independence required of general relativity (which exhibits general covariance and that extrinsic curvature has no meaning in modeling gravity). My updates here will clearly indicate that the example I gave for the hypothesis that negates Dark Energy in particular assumes a universe that has intrinsic curvature and will reemphasize that the metaphor used in my explanation, being a metaphor, is not a physical depiction that presumes a universe existing in a coordinate system (which would imply extrinsic curvature).

Before going further, I also need to notate here the reference to Moffat & Toth on the G/c variability in my first manuscript was incorrect as it related to the intent of their research (and as Toth correctly pointed out to me); however, the point that G/c can vary because G can vary is the main point I was communicating and maintain its validity (and which Toth did not dispute).

<u>Hypothesis Refinements to Refute Dark Energy Explanation of An Accelerating Expanding Universe</u>

In the figures provided in my prior manuscript depicting the relative universal acceleration of massive objects (Figures 4 and 6), the purpose of including them was to show how to maintain consistency between two metaphors that use topology (and its displacement) as a model for determining gravity potentials, ie. Gravity wells. In the case of Universal Gravity, the point was that a non-flat topology would have an implied gravity potential just like the localized gravity potential for a single object with mass M. Recognizing clearly that providing an implied orientation implicitly creates an embedding of the universal topology which appears as an extrinsic curvature rather than intrinsic, the claim that I was drawing a conclusion based on an extrinsic geometry is not correct. My counter-argument to that wrests on maintaining consistency in presenting a metaphorical, not physical, perspective:

Because the gravity well and universal gravity depictions are metaphors that are based on the same idea of expressing a potential (the topology of a Gravity Well to show a gravity potential in the localized case) is just as much a challenged example around external vs. internal curvature because it has an implied orientation, so there is consistency. Yet no one disputes the elegance of the Gravity Well concept to determine a magnitude of the gravity potential. And again, I can make a valid claim recognizing that as a metaphor only, the physics is meaningless in both cases and that doing so is based on maintaining consistency in the use of that metaphor.

As for the claim that the universe has intrinsic curvature and that my metaphorical examples are not assuming an extrinsic curvature as part of an implied embedded universe, we can easily point to other universal contexts that depict absolute orientation without requiring an embedded, coordinate universe, namely:

- Time – A number of well-credentialed scientists today believe that a universal time direction does exist (one way; forward) and is apart from the spacetime time associated with any inertial reference frame, including black holes where time is thought to stand still;

- Spin – At both the atomic and particle scale as well as galactic scale, the concept of spin remains unchallenged – there is Up spin and Down spin; there has to be a relative orientation to describe spin around an axis, whether describing a binary star system or subatomic particles;

- Mass attraction – There is no dispute that matter objects attracts one another and, moreover, they do not repulse ever under any circumstance. In fact, my whole premise is that gravity does this because it exhibits influence over every object in the universe from a dimension we cannot articulate in a physical, spacial sense, but when modeled as I have alluded to my manuscripts, can explain both matter attraction and at the same time the expanding universe.

Continuing the build of the discussion on physical rather than metaphorical grounds, the universal gravity concept proposed does work in a universe that has intrinsic curvature and this could have been caused by the big bang event in such a way that the energy released during the inflationary period would leave a permanent deformation (or curvature) during the post-inflationary period of the universe. This is consistent with the uniformity of heat distribution that would have only been possible the way Alan Guth described inflation. However, from my prior manuscript, I believe, a priori, that the force of gravity was not created at the big bang, but was instead *its cause* and a result of a prior universe end-of-life. Given an intrinsically curved, non-flat universe, the least action principle would apply: Namely, that the observation of an accelerating universe where every observable object is accelerating away in all direction MUST mean that the motion is also abiding by the least-action principal which is only possible if the spacetime curvature on a universal scale has a residual degree of curvature post big bang to explain this effect (without requiring Dark Energy).

As stated in my previous manuscript, the gravity effect is the curving of spacetime not only in the local region, but universally (although different degree of curvature) and that this could easily be tested with an experiment that shows the relative acceleration of near-objects that are very different in size. To reiterate from my prior manuscript, the experiment would show that if the larger object accelerated away more slowly, that it could be explained by a viscous resistance associated with the localized gravity wave in comparison to the near-object which moves more freely due to less localized spacetime curvature and a lower magnitude gravitational wave. (Obviously the gravitational waves of each object move at the speed of light, c, but the magnitude of each is different and could affect the observed observations of universal gravity on outward acceleration due to viscous resistance of the spacetime fabric in which it moves.)

Hypothesis Refinements to Refute the Dark Matter Explanation for Calculating Observed Rotational Dynamics of Celestial Bodies

What I stated in my prior manuscript is that if the stress and strain of a spacetime event exceeds an elastic limit, there would be permanent deformation – strain hardening (loss of elasticity and rebound), possibly something akin to necking and finally failure or rupture. If you look at the Bullet Cluster event, for example, and the going in assumption is that that event involved enough colliding energy and matter to create a permanent deformation in spacetime, then two things become apparent (1) gravity calculations (based on "Big M" mass) must necessarily separate from matter because matter is no longer telling spacetime how to curve for that region – it is permanently warped, and (2) the observations of extra matter that are purported to be dark matter and nothing more than the signature of a permanently warped spacetime region, such that if you knew the curvature of that permanently warped region, you could back into the gravity effects on the visible matter, essentially modeling the shape of that warped region. The gravitational constant, G, would effectively become variable.

The two important points are that: (1) at a stress failure point in spacetime, covariance ceases to exist in general relativity and (2) mass is really nothing more than a scalar factor to describe the gravitational energy (KE + PE) when the spacetime curvature/region exhibits general covariance with matter (when there is perfect elasticity of the fabric of spacetime, which is most of the time and assumed by General Relativity). However, since matter no longer couples with the spacetime region in certain instances, namely when spacetime stress and deformation reach a failure point, then matter alone and Big M mass lose their connectedness. (Little m still has meaning.) ***Mass therefore is persistent in the signature of the gravitational curvature of spacetime, but not in the matter that created the spacetime curvature. The logic failure heretofore that has created the need to consider Dark Matter is that matter and Mass are immutably related and that is only true of spacetime is perfectly elastic.***

Prevailing literature, investigative review, and the philosophy of physics seem to hang on the conundrum of merging the very different worlds of quantum physics with general relativity, looking for a combined quantum gravity solution. My point of view, which is based purely on irrefutable logic, common sense, and clarity around other aspects of our world is that the characteristics and properties of spacetime are misunderstood. My view is that spacetime has distinct behavior in the way it is characterized as a medium with topology. Just as bodies of water and oceans on the earth flow, create waves, are displaced by vessels, have turbulent disruption in storms, so too does spacetime react in its interaction with matter – any sized matter, the larger, the greater the effect. A spider can walk on water due to surface tension while the Oasis of the Seas is a cruise ship that displaces 225,000 tons of water every few seconds while at cruising speed. No one asks about how the water molecules and atoms that make up the volume of water all work in harmony to create the tension and fluid effects of water. In a similar way, our planet, the stars, and galaxies, each in their own way curve spacetime. (Galaxies are a bit different and will describe that further.)

To be sure, no one denies that general relativity and Einstein had it correct in elevating the awareness to the intimate interactions between matter and spacetime; namely that matter tells spacetime how to curve and spacetime tells matter how to move. The earth rotates around the sun based on the least action principle and so its rotation is nothing more than the most direct geodesic path in the spacetime curved by the sun. No one knows why this works, but it works. So given that it works, why is it difficult to conclude that spacetime has both a consistency and set of ascribed topological attributes? The prevailing hang up is that we are dealing with what we call "the vacuum" and that spacetime is perfectly elastic. But if the empty universe is a vacuum, then what are we curving when we say matter curves spacetime? If, in the widely accepted and proven theory of general relativity, we are unequivocally stating that we are curving "something" and we have metric tensors to describe that curvature and manifolds to describe the geometry, then we are dealing with a topology – vacuum or not. The mistake is getting hung up on the fundamental particles on Plank scales and how that quantum domain manifests itself at a macro-level into this thing we call gravity (never mind spooky action-at-a-distance which just compounds the problem).

My view is the topology of spacetime includes that something we call gravity – which is the curving of spacetime based on KE+PE interactions of matter, **but that MASS belongs to a different dimension that drives the topology universally**. This is also consistent with the metaphor of gravity acting on flat spacetime topology from the "normal" perpendicular direction, where such direction is emblematic of a separate dimension (although, again as a metaphor, different from the Cartesian 3D coordinate system). When the fabric of spacetime ruptures or strains past its elastic limit, matter and (Big M mass) de-couple and the covariant, symmetric general relativity becomes invariant and asymmetrical. That is to say, the Einstein field equations don't apply in that case. The central point is that if you define mass mathematically as belonging to its own dimension (not the passive gravity of "little m" but the active gravity of "big M") such that spacetime becomes a 5-dimensional construct, now you can maintain general covariance, but still be talking about a universal orientation.

How do we bring this concept to life mathematically?

Rethinking the Mathematical Constructs of Mass-Spacetime Interactions

First, we start with the assumption that Mass represents a different dimension from the matter that gives rise to the calculation of mass when calculating active gravity. If Mass is part of the spacetime definition, it is the scalar value that determines the degree of curvature for x,y,z and time. It is influenced by the matter presence, but in extreme conditions, that mass component may not dissipate. Observations of galactic rotation curves and very large object interactions imply a mass presence not part of the observable physical matter. Currently the weak field approximation is used to solve for the Schwarzschild solution to the metric tensor which is fine since that solution assumes that matter / spacetime interactions are always perfectly elastic. This is NOT true if spacetime has the potential for permanent warping and if it does, Mass **must** be able to separate from Matter making the Einstein field equations not applicable in those cases.

Thus we either have a 5-space: x, y, z, t, M, where M is the residual Mass calculated as the lasting curvature deformation impact to the affected spacetime region after the causal matter has departed OR we maintain a 4-space: x, y, z, t where the Gravitational Constant, C, changes to account for the permanently distorted spacetime region. If the former, we are separating "Big M" from the matter-energy stress-energy tensor and putting it into the Riemann metric tensor, and if the latter, M combines with G and is recalculated as a new constant to reflect the permanent spacetime deformation. When we do that, we can explain what we see in observed celestial dynamics and their relativistic effects by assuming a lasting change occurs to spacetime (permanent space-time stretching) instead of lasting increases in Mass to make the dynamic calculations work. If we apply this perspective to events like the bullet cluster, we can explain the observed dynamic effects without requiring dark matter.

Another way to summarize in convincing fashion this monumental shift in how we model celestial dynamics (and truly what has always been the undisputed case in terms of the premise for general relativity) is that in the end, you only have Matter and Spacetime. It is only these two factors that define any theory of celestial dynamics and up until now, when calculations of relativistic dynamics did not hold, it was assumed Mass had to be the incorrect variable. But why not the topology of spacetime? Once you allow spacetime to be variable – and specifically the topology to have permanent warping, the possibilities for modeling what we see in the cosmos become staggering.

So what would we say for example when addressing the galaxy rotation curve problem? In the prior manuscript, I explained the permanent spacetime deformation of an entire galactic region in the shape of a pan to maintain consistency with the metaphor of applying a displacement to a region that represented a gravity potential and that a broad pan shape replaces a localized gravity well to explain the "wall capture" of outer rotating galactic matter caught in the rotational tidal flow as observed by existing data for galactic rotation curves. In the real physical sense, I am also saying that the galactic region has intrinsic curvature, but not because of a central black hole that does not have sufficient matter (and hence big M) to explain the angular velocity of the galactic rotation at the outer edges, but instead, a permanently curved spacetime region – the entire galactic region – as a result of longstanding deformation due to the turbulent flow of all matter rotating around the galactic center and moving outward over its history. That longstanding deformation is essentially an erosion of the spacetime elasticity, creating permanent curvature or warping of the intrinsic topology of the galactic region. One could apply a mathematical erosion model to depict this effect, essentially modifying the "least action" worldline for any geodesic motion to reflect a permanent warping over time. Computational fluid dynamics is a place to start and includes turbulence models that measure viscosity, kinetic energy, and applies conservation of mass, momentum and kinetic energy to arrive at the descriptive equations for turbulence models including the low Reynolds number (LRN) k-ε turbulence model and the Reynolds stress transport model (RSTM).[2]

Below are my proposed steps to back into the application of the metric tensor in such a scenario where spacetime is permanently warped. Note that this is a prescription that will require further refinement from mathematicians and physicists; what I outline here is simply a directional prescription that at least lays the foundation by including the paradigm shift in thinking and going-in assumptions about Mass, Matter, and spacetime behavior. Clearly this will require commitment from well-credentialed mathematical physicists to flesh out and my hope is that I have given enough of a push here to generate the excitement and momentum to refine these model precepts.

[2] Predictive Models for Erosion-Corrosion Under Disturbed Flow Conditions, J. Postlethwaite, S. Nesic, G. Adamopoulus, and D.J. Berstrom, Univ of Saskatchewan, 1993

1. Starting with the Einstein Field equations, we look at solutions to the Friedmann–Lemaître–Robertson–Walker (FLRW) metric as it has been well documented (below from Wikipedia) to see how physicists today represent Dark Energy, and then afterward in #2 below, a discussion on a different interpretation that doesn't require Dark Energy. In Step 1, you will see that Dark Energy is characterized as nothing more than a mathematical plug to adjust the cosmological constant and moreover, this analysis articulates what I have already represented about instrinsic curvature of the universe – namely that "positive total energy represents negative curvature" where positive total energy implies an accelerating, expanding universe.

   Below is the direct extract from Wikipedia to set up as a point of reference; again this is Step 1 in my approach to compare the math related to the Dark Energy interpretation to mine in Step 2:

   > For the FRLW metric, the Einstein's field equations are not used in deriving the general form for the metric: it follows from the geometric properties of homogeneity and isotropy. However, determining the time evolution of $a(t)$ does require Einstein's field equations together with a way of calculating the density, $\rho(t)$, such as a cosmological equation of state.
   >
   > This metric has an analytic solution to Einstein's field equations $G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$ giving the Friedmann equations when the energy-momentum tensor is similarly assumed to be isotropic and homogeneous. The resulting equations are:[5]
   >
   > $$\left(\frac{\dot{a}}{a}\right)^2 + \frac{kc^2}{a^2} - \frac{\Lambda c^2}{3} = \frac{8\pi G}{3}\rho$$
   > $$2\frac{\ddot{a}}{a} + \left(\frac{\dot{a}}{a}\right)^2 + \frac{kc^2}{a^2} - \Lambda c^2 = -\frac{8\pi G}{c^2}p.$$
   >
   > These equations are the basis of the standard big bang cosmological model including the current ΛCDM model. Because the FLRW model assumes homogeneity, some popular accounts mistakenly assert that the big bang model cannot account for the observed lumpiness of the universe. In a strictly FLRW model, there are no clusters of galaxies, stars or people, since these are objects much denser than a typical part of the universe. Nonetheless, the FLRW model is used as a first approximation for the evolution of the real, lumpy universe because it is simple to calculate, and models which calculate the lumpiness in the universe are added onto the FLRW models as extensions. Most cosmologists agree that the observable universe is well approximated by an *almost FLRW model*, i.e., a model which follows the FLRW metric apart from primordial density fluctuations. As of 2003, the theoretical implications of the various extensions to the FLRW model appear to be well understood, and the goal is to make these consistent with observations from COBE and WMAP.
   >
   > **Interpretation[edit]**
   >
   > The pair of equations given above is equivalent to the following pair of equations
   >
   > $$\dot{\rho} = -3\frac{\dot{a}}{a}\left(\rho + \frac{p}{c^2}\right)$$

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3}\left(\rho + \frac{3p}{c^2}\right) + \frac{\Lambda c^2}{3}$$

with k, the spatial curvature index, serving as a constant of integration for the second equation.

The first equation can be derived also from thermodynamical considerations and is equivalent to the first law of thermodynamics, assuming the expansion of the universe is an adiabatic process (which is implicitly assumed in the derivation of the Friedmann–Lemaître–Robertson–Walker metric).

The second equation states that both the energy density and the pressure cause the expansion rate of the universe $\dot{a}$ to decrease, i.e., both cause a deceleration in the expansion of the universe. This is a consequence of gravitation, with pressure playing a similar role to that of energy (or mass) density, according to the principles of general relativity. The cosmological constant, on the other hand, causes an acceleration in the expansion of the universe.

The cosmological constant term[edit]

The cosmological constant term can be omitted if we make the following replacement

$$\rho \rightarrow \rho + \frac{\Lambda c^2}{8\pi G}$$
$$p \rightarrow p - \frac{\Lambda c^4}{8\pi G}.$$

Therefore the cosmological constant can be interpreted as arising from a form of energy which has negative pressure, equal in magnitude to its (positive) energy density:

$$p = -\rho c^2.$$

Such form of energy—a generalization of the notion of a cosmological constant—is known as dark energy.

In fact, in order to get a term which causes an acceleration of the universe expansion, it is enough to have a scalar field which satisfies

$$p < -\frac{\rho c^2}{3}.$$

Such a field is sometimes called quintessence.

Newtonian interpretation[edit]

The Friedmann equations are equivalent to this pair of equations:

$$-a^3\dot{\rho} = 3a^2\dot{a}\rho + \frac{3a^2 p\dot{a}}{c^2}$$

$$\frac{\dot{a}^2}{2} - \frac{G\frac{4\pi a^3}{3}\rho}{a} = -\frac{kc^2}{2}.$$

The first equation says that the decrease in the mass contained in a fixed cube (whose side is momentarily *a*) is the amount which leaves through the sides due to the expansion of the universe plus the mass equivalent of the work done by pressure against the material being expelled. This is the conservation of mass-energy (first law of thermodynamics) contained within a part of the universe.

The second equation says that the kinetic energy (seen from the origin) of a particle of unit mass moving with the expansion plus its (negative) gravitational potential energy (relative to the mass contained in the sphere of matter closer to the origin) is equal to a constant related to the curvature of the universe. In other words, the energy (relative to the origin) of a co-moving particle in free-fall is conserved. General relativity merely adds a connection between the spatial curvature of the universe and the energy of such a particle: positive total energy implies negative curvature and negative total energy implies positive curvature.

The cosmological constant term is assumed to be treated as dark energy and thus merged into the density and pressure terms.

5. P. Ojeda and H. Rosu (2006), "Supersymmetry of FRW barotropic cosmologies", *International Journal of Theoretical Physics* **45** (6): 1191–1196, arXiv:gr-qc/0510004, Bibcode:2006IJTP...45.1152R, doi:10.1007/s10773-006-9123-2

2. From the above, Step 2 is to comment on the FLRW metric and how it interprets the cosmological constant and then to provide a different interpretation here:

   a. The interpretation above assumes that the cosmological constant arises out of a form of energy (or pressure) that is the causal factor in the outwardly accelerating universe. This is a consciously chosen interpretation and necessitates the presence of Dark Energy as stated above and also by the Standard Model (ΛCDM) with the cosmological constant associated with the stress-energy tensor from Einstein's Field Equations.

   b. My hypothesis instead states that the accelerated expansion of the universe is due to the spatial curvature of the universe which with negative curvature, k, would induce a repulsive effect due to universal gravity equivalent to the spatial curvature of the universe (intrinsic curvature) and not to some mysterious energy pressure. First let's re-write the Einstein field equations from above as:

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R + g_{\mu\nu}\Lambda = \frac{8\pi G}{c^4}T_{\mu\nu}$$

where:

- $R_{\mu\nu}$ = the Ricci curvature tensor

- R = the scalar curvature
- $g_{\mu\nu}$ = the metric tensor
- Λ = the cosmological constant
- G = the gravitational constant
- $T_{\mu\nu}$ = the stress-energy tensor

Mathematically, I am stating that the cosmological constant, Λ, belongs with the metric tensor as Einstein had it previously to prevent the collapse of the universe due to the scalar curvature metric tensor component (- 1/2* $g_{\mu\nu} * R$ and which represents to local gravity spacetime curvature), ***but instead with a modification that the metric associated with the cosmological constant is a different metric***, and represents the spacetime curvature component of universal gravity, namely:

$\Xi\mu\nu * \Lambda$ where $\Xi\ \mu\nu$ would be the universal metric tensor representing the universal spacetime curvature and universal gravity that is causing the accelerating universe to expand.

This leaves a modified EFE to show as:

$$R_{\mu\nu} - (1/2)\, g_{\mu\nu} R + \Xi\mu\nu * \Lambda = \left(\frac{8\pi G}{c^4}\right) T_{\mu\nu}$$

To reiterate then, the stress-energy tensor on the right is the energy potential of the matter in question while the left side is the description of the spacetime curvature given by the Ricci tensor and metric tensor, plus an adjustment for the spacetime curvature not caused by the matter in question, but by the curvature of the universe.

3. The next step is to use measurements of the expanding universe in all directions to solve for the universal metric tensor and the cosmological constant. That will come from experimentation as mentioned above and described in my prior manuscript.

4. In terms of looking at the mathematics for explaining dark matter, physicists have already created models that modify Einstein's field equations to include a scalar potential Φ added to the Riemannian metric g_{ij}, as well as a scalar potential energy density **(c4/8ΠG)*** Φ to model the combination of Newtonian effects, dark matter effects (negative energy potential) and positive energy effects (dark energy) into a single model that explains observed behavior in the universe[3]. The key breakthrough in achieving this model is that the Riemannian metric g_{ij} need not be

[3] Tian Ma and Shouhong Wang, Gravitational Field Equations and Theory of Dark Matter and Dark Energy, 11 July 2012

divergent free. For the analysis provided by Ma and Wang, the highlight in their modeling was to add a scalar potential and potential energy density that calculates a revised gravitational mass **Ḿ** based on a theoretical total mass $\mathbf{M_T}$. So if Dark Matter and Dark Energy were to exist, this model works great and depicated as:

$$\mathbf{F = m*M*G*(-(1/r^2) - (k_0/r) + (k_1 r))}$$

where k_0 and k_1 are constants (see Rubin's Law).

However, what I am saying is that the physical explanation for the observation is not additional mass, but instead, a permanently warped spacetime topology. (Remember, Dark Matter and Dark Energy are still just theoretical; they are undiscovered and not yet observed as verified physical elements in the universe.) The scalar potential therefore needs to model effects of spacetime topology change – warping – and not a plug that represents the difference in mass required to maintain the coupling of matter and spacetime. What this means is that the Einstein Field Equations (EFE) shown in Step 2 properly model matter-spacetime interactions so long as there is not a permanent warping, and if there is permanent warping of spacetime, then the total mass in the above formula really represents mass from another world-line. With the presumption there is no dark matter, the Ricci Tensor and Metric tensor from the EFE have to be modified, not total Mass, and as described earlier in this manuscript, this changes the spacetime curvature to fit the measured dynamics and actual behavior of the observed matter.

Conclusion

My hypothesis that explanations for the expanding universe can be explained by the intrinsic curvature of the universe and that gravity acts on all matter in the negatively curved universe as evidenced by celestial observations can be supported by a mathematical model as suggested in this manuscript. Similarly, unexpected celestial body dynamics like the galaxy rotation problem can be explained as well by mathematical models that couple the Mass effect with spacetime topology, rather than with the matter that happens to have a value of Mass equal to the scalar value of all the Mass of the matter object. Rearranging mathematical terms and definitions associated with Einstein's field equations plus adding another term to show the persistence of spacetime curvature in the absence of matter to represent the permanent effect on spacetime topology caused by gravity (universally) takes the hypothetical realm away from a metaphorical discussion and into a tangible mathematical construct – a theoretical model – that I hope will gain more interest and attention from theoretical physicists and cosmologists that specialize in this area of study.

As stated in my prior manuscript, I believe that the quest to find answers to some of the most challenging problems in cosmology can be attained only by keeping an open mind and embracing alterative precepts that set up the problem domain, and specifically the going-in assumptions, especially when they include bold and different ideas. I believe that my greatest impact on this area of study is forcing our thinking about going-in assumptions to look in a different direction, but it will ultimately be up to the scientific community to decide if it wants to embrace bold new ideas.

What I have learned during the years I've spent thinking about this problem domain and trying to engage the scientific community is that the prevailing scientific method does not like big leaps in thinking, but instead has a strong preference for making incremental verifications or negative confirmations on already well-established theories. My hunch is that the uptake on any bold ideas may only come from those credentialed in mathematics and the philosophy of physics, for such a profile is not limited by scientific method when generating new ideas. My ideas are novel for sure, and I've provided enough directional insights, both mathematical and through logic, to hopeful incentivize further research on this important area of study.