The Structure of the Cosmos

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Abstract

Presented here is a theory in theoretical physics that describes a cosmic gravitational force and how it manifests differently across different manifolds. This theory describes the cosmos to exist in levels of manifolds, each having degrees of freedom in a specific number of dimensions, which makes the cosmic force have deviant properties per each manifold. In support of this concept, a modified version of the Einstein Field Equations (EFE) is given to aid in description of the manifolds and to show the relationships and trends across the manifolds.

1. Introduction

Ever since we realized that interactions are governed by forces, attempts have constantly been made to combine all the forces known to us. The concept of additional dimensions aside the ones of 4d spacetime has already been explored on numerous occasions [1][2][3]. Extra dimensions among others, offer approaches to unification of the fundamental forces and also solving the hierarchy problem. This paper further explores the force of gravity acting in manifolds of varying dimensions, in description of the physical structure of the cosmos.

We will first reduce all mechanical quantities to a single quantity (length), which is a measure of space, and examine the relationship between length and the other quantities. We will then look at gravity as a general cosmic force and how it manifests across spatial manifolds of different dimensions. Gravitational force itself arising as a result of variations in the geometric property of space [4], as described by General Relativity. We will then proceed to give a small – scale adaptation for the theory, thereby merging large – scale physics and small – scale physics.

2. Cosmic Property

Classical physics relies on three fundamental mechanical quantities of measurement (mass, length, time) from which the other quantities can be derived from. We wish to find the relationships between these three quantities and speak in one universal property.

From the *mass – energy equivalence principle* [5][6], the mass of a system is shown to be directly proportional to the energy in the system, by the famous equation,

Where *E* is energy, *c* is the causality constant, and *m* is mass,

$$E = mc^2 \tag{1a}$$

We get mass to be,

$$m = \frac{E}{c^2} \tag{1b}$$

From a similar process, we also learn the relationship between time and energy, Where *s* is length, and *t* is time,

$$E = \frac{cms}{t} \tag{2a}$$

We get time to be,

$$t = \frac{cms}{E} \tag{2b}$$

The mass – energy equivalence principle demonstrated by equation (1) relates mass of a system to the energy in the system. Equation (2) also relates time covered by a system to the energy in the system.

Since the curvature of space is as the result of mass concentration at that portion of the space [4], and the mass also being directly related to the energy of that portion [5]. The description of both mass and time in terms of energy also leads to the relation of both quantities to space and thereby length.

By substituting equation (1b) into equation (2b), we get,

$$t = \frac{cEs}{c^2E}$$

Which simplifies to,

$$t = \frac{s}{c} \tag{3}$$

Equation (3) gives the value of proper time τ, which is described by the equation as the length of distance covered per the rate of causality. This reenforces the notion that time is a property of length. This will come in handy as we look at time as a spatial manifold further on.

Now let us take a further look at equation (2b), we realize that as time increases, the energy in a given system ought to decrease. But from the law of energy conservation, the energy in a closed system cannot increase or decrease [6]. Therefore, the other variables must compensate for the supposed reduction in energy. The mass in a system is shown in equation (1) to be directly proportional to the energy of the system. Which means just like with energy, the mass is also conserved. This leaves us with length. So as time increases, the space occupied by the matter must increase to accommodate the supposed reduction in energy. We will call this the *time – energy compensation principle*. This principle also demonstrates the metric expansion of the cosmos [7].

3. Cosmic Force

From the cosmic expansion explanation in the previous chapter, all space in the universe is supposed to be expanding. This has been observed on the intergalactic scale [7]. But the question is: why are atoms not expanding? or why are we and everything else we see not falling apart? Obviously, it is because all matter is being held together by forces. The next question is: why then are some matter moving apart and some are still being held together? Obviously again, it is because some of the forces are stronger than others.

If we seek to explain the entire cosmos with the same force, then one of the alternatives we can consider to account for the expansive disparity is for matter to operate in different manifolds which have different dimensions. This will make the same force stronger in manifolds with higher number of dimensions.

Observationally, the cosmos at the bigger scale has been expanding [7] while no expansive behaviour has been observed at the smaller scales, yet. This leads to the implication that if the cosmos were to exist in layers of manifolds as postulated above, then the large – scale cosmos will operate in lower manifold layers with smaller number of dimensions.

For each manifold level, the degrees of freedom or dimensions at that level alone, is the same as the number of the manifold level. This means that matter at level – 1 manifold will operate in one – dimensional space, matter at level – 2 manifold will operate in two – dimensional space, and so on.

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \kappa_x T_{\mu\nu} \tag{4}$$

Modifying the Einstein Field Equations [4] for the described cosmic structure above, for each manifold layer, the rank of the tensors *D* will be the total dimensions of the manifold, which is the sum of dimensions of the given level and the dimensions of all lower levels.

Where *n* is the manifold level, and d_n is the number of dimensions at that manifold level alone,

$$d_n = n \tag{5}$$

Where d_t is the total number of dimensions for that manifold level (including all lower levels),

$$d_t = D = n! \tag{6}$$

Manifold Level (*n*)	Manifold's Dimensions (d_n)	*D* or Total Dimensions (d_t)	μ and ν components
1	1	1	0
2	2	3	0, 1, 2
3	3	6	0, 1, 2, 3, 4, 5
4	4	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
5	5	15	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

Table 1. Manifold levels, their corresponding dimensions, and μ and ν components

Let us elaborate more on the structural arrangement of matter in the cosmos. We will introduce new terms in the language to help simplify the description. First, we will define a system as matter operating in a specific manifold. Next, we will assign names to systems of every manifold:

Level – 1 manifold - Universe (*u*)
Level – 2 manifold - Ether (*e*)
Level – 3 manifold - Physic (*p*)
Level – 4 manifold - Atom (*a*)
Level – 5 manifold - Quintessence (*q*)

So, the one – dimensional level – 1 manifold is the universal system. The universal system contains several ethereal systems. Ethereal systems containing physical systems, with our galaxy and all observable matter in it being an example. Physical systems will also contain atomic systems. And following the age – old convention, we will use the term quintessential system for a fifth system which we have not observed yet, that will be on a scale smaller than even that of the atom.

Notice on the right – hand side of the modified EFE of equation (4), the constant κ_x instead of the usual Einstein's gravitational constant κ. The new term κ_x is the variable gravitational constant. It is a variable constant because it changes with manifold levels and systems. Its value depends on the energy density of the system and that of its parent systems. Systems having similar energy densities will have similar values for κ_x, and will also tend to exhibit similar properties.

Now, solving the modified EFE for a universal system with *D = 1*, with its rank one tensor will outrightly result in a gravitational field of a point mass, which will give an infinite gravity [4][8][9]. This infinite gravity drives everything in it along which gives rise to the notion of one – dimensional time. Remember from equation (3) that proper time is length per causality rate. Thus, time as we know it, is a one – dimensional space of the level – 1 manifold that is being driven at the rate of the causality rate *c*.

Solving the modified EFE for an ethereal system with *D = 3* will result in a gravitational force much weaker than Newtonian gravity. This force will be incapable of holding matter at that scale together as compared to the other higher manifold levels. Thereby accounting for the observed expansion of the universe at larger scales. This also removes the need for the cosmological constant in the original EFE.

Solving the modified EFE for a physical system with *D = 6*, since the force of the containing ethereal system is relatively too weak to make an impact in the physical system, the components for $\mu, \nu = 1, 2$ will approximate to zero. This will reduce the tensors of the equation from rank 6 to rank 4, which will result in the usual Minkowski 4d spacetime [10] with *D = 4*.

4. Small Scale Adaptation

This theory has so far explained the large – scale portion of the cosmos. If we observe the trend, it is not far – off for it to cover the structure of matter at the small – scale level as well, and even at smaller scales not available to us yet.

Solving the modified EFE for an atomic system with *D = 10*, the components for $\mu, \nu = 1, 2, 3, 4, 5$, which represents the components of the ethereal and physical systems, will approximate to zero because of the relative weakness of the forces at those levels. This will reduce the tensors of the equation from rank 10 to rank 5. Thus, we get *D = 5* for a typical atomic system, with one – dimensional time and four spatial dimensions. Unlike the fifth dimension of the Kaluza – Klein Theory [1][3][11] which is added on top of the usual 3d spatial dimensions, all the four spatial dimensions of an atomic system are microscopic and are totally separate from the three spatial dimensions of the physical system.

Let us analyse some trends across manifold levels, most of these have been made obvious by now.

1. Energy density increases with higher manifolds.
2. Number of dimensions increases with higher manifolds.
3. System size decreases with higher manifolds.
4. Force intensity increases with higher manifolds.
5. Range of force decreases with higher manifolds.
6. Rate of events increases with higher manifolds.

Given enough time, clouds around the nucleus of systems in all manifold levels will tend to orbit the nucleus of the system in a flat disc shape as analogous to a galactic disc [12], due to collisions of the clouds coupled with the conservation of angular momentum. This situation is almost always true for an atomic system because the rate of events is faster relative to us, which gives the system ample time to form the disc. In ethereal and physical systems, the disc of the orbiting cloud forms in one plane. However, in atomic and quintessential systems, due to the added extra dimensions, the orbiting clouds are able to operate in two planes without interacting with each other.

Sections of the cloud disc orbiting the nucleus of a system gives the energy level of that section. In an atomic system, because of the two planes of orbit of the cloud discs, there are always two sections of the cloud with the same energy level, but in different orbiting planes.

Where E_r is the energy level of a section of cloud disc of radius *r* away from the nucleus of a system, m_r is the mass of the section, and ω_r is the angular velocity of the section,

$$E_r = m_r \omega_r^2 r^2 \tag{7}$$

For an atomic system, the total energy level of a section of cloud $E_{r(a)}$ is given by,

$$E_{r(a)} = 2m_r \omega_r^2 r^2 \tag{8}$$

The coefficient of *2* is due to the two cloud discs in two different planes.

As this is an adaptation of large – scale physics, other phenomenon associated with general relativity such as gravitational waves are suspected to account for some of the other behaviours of the atomic system. But these are cases we are not going to explore currently in this paper.

5. Conclusion

This paper presents the view that length, which is a measure of space is the basic property of the cosmos, from which we get all other mechanical quantities or properties. Also, all space is expanding but some portions of space are expanding more than others. This is as a result of a gravity – like cosmic force that tends to have different strengths depending on which manifold level it is acting in.

This paper does not seek to disprove the myriads of theories and models that are already doing the outstanding job of explaining physics as we know it. Or those in the pipeline that seek to merge the realms of large – scale physics and the small – scale physics. Rather, unlike the various models, the theory presented here describes the physical look of the cosmos at all scales. This still give room for models to describe physics in their own language and from their own perspectives.

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