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The GeometroDynamic Model (GDM)

Versus

String Theory (ST)

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Abstract

Physical phenomena and their relevant theories are categorized as Foundations of Physics:

- A. Electromagnetism (EM) and Quantum Electro Dynamics (QED) deal with the bivalent electric charges, photons and their interactions - Electromagnetic force.
- B. Gravitomagnetism and General Relativity (GR) deal with masses, gravitons and their interactions – the Gravitational force.
- C. The Standard Model of Elementary Particles (EPs) and Quantum Chromo Dynamics (QCD) deal with the EPs interactions – Strong force (The Weak force is electromagnetic).
- D. Quantum Mechanics (QM) deals with interactions on the microscopic level.
- E. A Unifying Foundation, that unifies the above four foundations, attempts to present the three forces of nature as one.

String Theory (ST) is considered a Unifying Foundation. This mathematical theory, however, is not isomorphic to reality. It fails to derive and calculate attributes of EPs, leaves important issues open, and does not suggest experiments to verify or falsify its contentions.

Our GeometroDynamic Model (GDM) is also a Unifying Foundation. But, in contrast to String Theory, the GDM derives and calculates attributes of EPs, shows all the forces to be

manifestations of density and tension within space, solves important long-standing issues, and suggests experiments to verify or falsify its contentions. The GDM serves as an underlying theory to the four basic foundations and does not require any new mathematics or extra dimensions. The GDM single postulate: **the elastic space is all there is**, gives it all.

Keywords: Electromagnetism, QED, Gravitation, General Relativity, Standard Model, QM, String Theory, GDM

1 Introduction

1.1 Space and particles

In ST particles are different kinds of strings, which are fundamental and alien to space. This raises the question - what is spacetime. Brian Greene in his book [1] p.486 suggests that: *...may be spacetime is stitched out of strings....to make sense of this proposal, we would need a framework for describing strings that does not assume from the get-go that they are vibrating in a preexisting spacetime...*

E. Witten [2], in a recent paper on ST (2015) also relates to this issue:

In general, a string theory comes with no particular spacetime interpretation, but such an interpretation can emerge in a suitable limit, somewhat as classical mechanics sometimes arises as a limit of quantum mechanics. From this point of view, spacetime emerges from a seemingly more fundamental concept of 2D conformal field theory.

In contrast, the GDM considers particles to be moving wavepackets of the elastic 3D space itself. They are not alien to space; they are only geometrodynamical structures moving in it.

1.2 Space dimensionality

In the M-theory of ST, the newly predicted number of dimensions is 11D. Thomas Andrew in his book (for non-experts in the field) [3], gives a very clear, simple and compact review of

ST and explains how in ST the number of dimensions is derived and calculated.

In contrast the GDM considers space dimensions to be the conventional 3D.

2 Unification

2.1 Conventional Methods

For two theories, of two apparently different and unrelated sets of phenomena of nature, we might try to construct a single theory that integrates them. This single theory should derive and calculate phenomena of these two sets in one and the same way - gravitation and electromagnetism are an example. This process is termed - **unification**. One common way of unification is to introduce extra spatial dimensions, as if the phenomena of each set take place in a different set of dimensions.

From Wikipedia [4] on the history of unification attempts:

*..... creating a unified field theory began with the Riemannian geometry of general relativity, and attempted to incorporate electromagnetic fields into a more general geometry, since ordinary Riemannian geometry seemed incapable of expressing the properties of the electromagnetic field (which we, on the contrary, **showed to be capable**). Einstein was not alone in his attempts to unify electromagnetism and gravity; a large number of mathematicians and physicists, including Hermann Weyl, Arthur Eddington, and Theodor Kaluza also attempted to develop approaches that could unify these interactions. These scientists pursued several avenues of generalization, including extending the foundations of geometry and **adding an extra spatial dimension**.*

On the Theodor Kaluza work see also [3] pp.94-95.

Brian Greene in his book: The Elegant Universe [5], remarks: *Kaluza's suggestion has revolutionized our formulation of physical law. We are still feeling the aftershocks of his*

astonishingly prescient insight.

From Wikipedia [4] on current efforts:

Current mainstream research on unified field theories focuses on the problem of creating a quantum theory of gravity and unifying with the other fundamental theories in physics, all of which are quantum field theories. (Some programs, such as string theory, attempt to solve both of these problems at once.) Of the four known fundamental forces, gravity remains the one force for which unification with the others proves problematic.

Although new "classical" unified field theories continue to be proposed from time to time, often involving non-traditional elements such as spinors, none has been generally accepted by physicists.

2.2 The GDM Unification

2.2.1 The Geometrodynamics of Space

The GDM presents a **different approach** to the issue of unification. **Instead** of adding dimensions, which we consider a formal, even artificial, way of unification, we have explored the possibility that **all phenomena** have a common denominator. This common denominator is the **geometrodynamics of space**, since in the GDM **space is all there is**. Thus Riemannian geometry, applied to deformed spaces rather than to bent manifolds [6], becomes the GDM mathematical tool to explore the reality.

2.2.2 Unification

The unification of electromagnetism and gravitation, in the GDM, is obtained by revealing the essence of electric charge. In [7], [8], we show that charge and its field are curved space. This paves the way [9] for extending the GR equation to become an equation of both the energy/momentum and charge/current tensors, and with no extra dimensions. By showing that

the Strong Force is an electromagnetic force [10], the unification of all three forces is achieved.

2.2.3 On the Derivation and Calculation of the Elementary Particles' Masses [7] [8]

Using GR we arrive at the conclusion that the bivalent elementary charges are a black hole (positive charge) and a white hole (negative charge). They can be considered as hard balls with finite size. They possess the same energy (mass) of contraction as that of dilation.

These balls are longitudinal waves of contraction and dilation. As such, they move at the longitudinal wave velocity c_L . But space contraction and dilation (the electric fields) around them are created and annihilated at the lower transversal wave velocity c_T (light velocity). This explains the self-interaction of a charge with its own field.

This is all we need to derive and calculate the masses; An elementary particle is thus a “micro binary star system” of the interacting elementary charge and its moving image [7] [8].

2.2.4 Quantization

We are left with the issue of quantization, which is discussed in the next sections.

3 Unification of Gravitation and Electromagnetism

Exploring the essence of electric charge, we found that by defining charge as nothing but curved space we are able to derive the entire Maxwellian Electromagnetic theory, without any phenomenology. This result enables us to extend Einstein's equation of General Relativity (GR) to become an equation that incorporates not only the energy/momentum tensor ($T_m^{\mu\nu}$), but also the charge/current tensor ($T_q^{\mu\nu}$).

This equation becomes a macroscopic/microscopic equation of the entire physical reality. Charge and angular momentum are quantized and thus we predict that the curvature of spacetime is also quantized [8].

$$R^{\mu\nu} - 1/2Rg^{\mu\nu} = 8\pi G/c^4 \cdot T_m^{\mu\nu} + 4\pi G^{1/2}/s^2 \cdot T_q^{\mu\nu}$$

where $S = 1$ and $[S] = \text{cm/sec}$

In the past, efforts were made to incorporate the energy/momentum tensor of the electromagnetic field in the GR equation. The common denominator of all these efforts to unify gravitation and electromagnetism was the idea that only energy/momentum curves spacetime. In contrast, we show that the right-hand-side of the GR equation expresses curving by angular momentum and charge. Curving by angular momentum is related to frame dragging, whereas charge is simply curved space.

4 The Quantized Space Curvature

The quantization of spacetime curvature is due to quantized angular momentum and charge [9]. Thus, the creation of a pair of a particle and its anti-particle contributes twice to the curving by spin (and relevant energy). There is no contribution to curvature by a pair of bivalent elementary charges since the contributions of positive and negative curving cancel out. Note that in our theory - the GDM [11], gravitation [9] is space contraction (curving) [6]. Thus “quantizing gravitation” means that the amount of contraction jumps from one value to another by a quantum of contraction. The annihilation of a pair of a particle and its anti-particle subtracts twice the curving by spin (and relevant energy). This loss in curving (contraction), which is necessarily quantized, is a loss in space torsion and its relevant energy. This is more than a clue as to how the graviton is constructed. To construct a model of the graviton we must first relate to our models of the photon and its ground state photom [12], which are space wavepackets [11].

To summarize:

The curving of space is quantized. The minimal change in curving is a quantum of contraction or dilation. A graviton is created by a quantum reduction in curvature (contraction). Pair annihilation is an example. This graviton is a wavepacket of a transversal oscillating contraction and dilation of space, and as such it is massless. A gravitational wave is many gravitons in phase.

5 The Photon and Photom [12]

We model the Photon as a space lattice oscillation, in a plane perpendicular to its line of propagation. This propagation is at the light velocity c . This plane is vertical or horizontal or rotating clockwise or anti-clockwise. This oscillation occupies a finite space volume of a defined shape, structure and size. Papers [7] and [8] model electromagnetism as the geometrodynamics of space; we show that the elastic space lattice oscillating displacement vector is the oscillating electric field, pointing in the opposite direction. For simplicity we ignore the magnetic field. We also show that photons and ground state photons - the photoms, condense when they are in phase and disperse when in anti-phase. This feature explains the double-slit experiment, both for an ensemble of photons (classical EM wave) and single photons. It dispels the need for attributing a dualistic nature to single photons that arrive at the screen one at a time.

6 The Graviton and Gravitom [13]

6.1 The Graviton as a Massless Spin-2 Boson

The nature of the expected graviton is discussed, in a very clear and compact way, in the introduction by Brian Hatfield (*Spin of the Graviton and Antigravity*) to the book: Feynman: Lectures on Gravitation [14].

6.2 The Gravitational wave

Gravitational waves, predicted by GR [15], are space waves that have recently been detected [16].

Fig. (3) shows the effect of a linear polarized gravitational wave (Plus Polarization) on a ring of particles [17]. This wave moves towards us perpendicularly to the page and through it, at different times. These times are the quarters of the cycle time T . This wave is a transversal wave of contracted and dilated space, with their axes of contraction and dilation perpendicular to each other and to the direction of propagation. As a transversal wave it moves at the light velocity c .

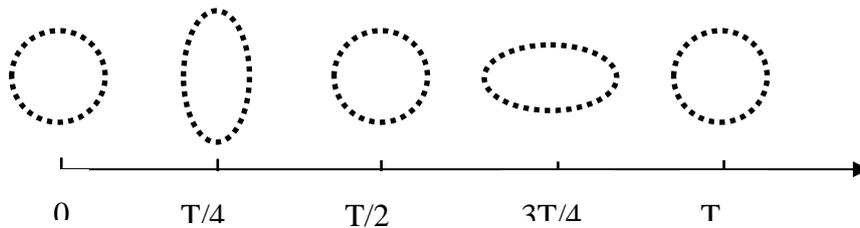


Fig. (3) The Gravitational Wave (Plus Polarization)

At $T = 0$ space is the un-deformed (standard, normal) space. After $T/4$ space is dilated (stretched) vertically and contracted horizontally. At $T/2$ space is again un-deformed, and at $3T/4$ space is contracted vertically and dilated (stretched) horizontally.

The second linear polarization is tilted by $\pi/4$ rather than $\pi/2$ since the spin is $s = 2$. This polarization is called – Cross Polarization (in Fig. (3), the ellipses are rotated clockwise by 45 degrees).

The Graviton model should, necessarily, comply with that of the gravitational wave.

6.3 The Graviton (G) Model (Structure)

Inspired by Figures (1), (2) and (3), we **invent** the graviton.

Fig. (4) shows our cylindrical cross-like graviton moving towards us, with a velocity c , perpendicular to the page and through it, at different times. These times are the quarters of the cycle time T .

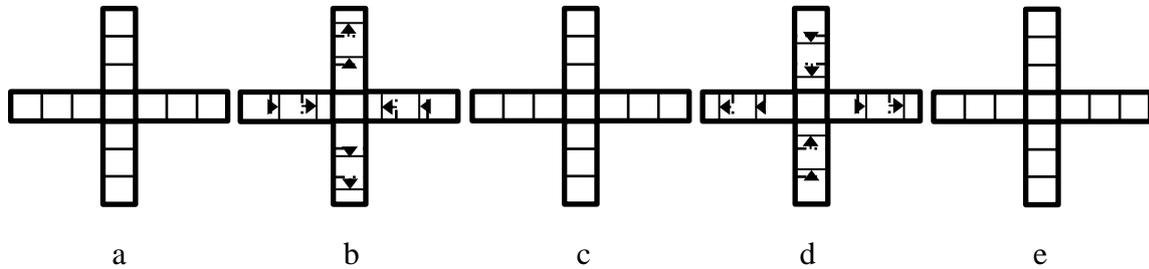


Fig. (4) The Graviton

At $T = 0$, see Fig. (4a), space is un-deformed (standard, normal). After $T/4$, see Fig. (4b), space is dilated (stretched) vertically (as if constructed by two opposing vertical negative photoms), and contracted horizontally (as if constructed by two opposing horizontal positive photoms). At $T/2$ space is un-deformed, and at $3T/4$ space is contracted vertically and dilated horizontally. This construction is good for gravitons with linear plus and cross polarizations or circular polarizations. In Section 5.2 we bring an argument as to why the graviton is a combined oscillation of space contraction and dilation.

6.4 The Gravitom and the Photom

Fig. (4) shows that a graviton is constructed of two positive photoms and two negative photoms. We can, therefore, consider the ground state of gravitons to be that of photons. We expect the ground state of space to create space polarization. It affects, not only electric interactions, but also gravitational interactions, since **a neutral mass curves space positively like a positive charge**. Evidence for this possibility appears in [13].

7 The Graviton versus the Photon

Both the Photon/Photom and the Graviton/Gravitom are transversal wave packets, but the ground state wavepackets-**the Photom and the Gravitom - are identical.**

7.1 The G Spin

The spin of each photom is $1/2 \hbar$. Since the graviton is constructed of 4 photoms its spin must be $s = 2$, hence:

$$L_G = 2 \hbar \quad (1)$$

Note that in pair annihilation, in order to conserve angular momentum, usually two photons and a graviton are created; see Section 5.2 in [13].

7.2 The G Energy

Let a pair with a combined mass M' be located on the surface of a mass M . The gravitational energy of the system M' and M due to the presence of M' is:

$$U_G = - GMM'/R \quad (2)$$

R being the radius of M (we neglect the self-gravitational energy of the pair).

The annihilation of the pair is a loss of gravitational energy. It is **a long-standing issue** as to where did this gravitational energy disappear. We suggest that this energy is carried by a graviton, which leaves the system at velocity c .

Note that, according to the GDM the elementary bivalent charges are contracted and dilated zones of space. Hence, it is natural to expect that their annihilation creates a ripple in space, which is a combined space oscillation of contraction and dilation. This understanding enables us to calculate typical graviton energies. Our models of both the photon and the graviton lead us to conclude that the graviton energy U is related to its angular frequency ω by:

$$U = 2\hbar\omega \quad (3)$$

7.3 The Graviton versus the Photon

In the electromagnetic field, a single mode can be excited, equally, n times and own energy $(n+1/2)\hbar\omega$. This, however, is not the case for the graviton. **In the “gravitational field”, each graviton owns its specific, individual, quantum of energy (3), according to the quantum reduction in curvature (contraction) of its source. A graviton, although its energy comes as a quantum, unlike the photon it is not an excited mode of some kind.**

Summary

Our unified model of reality - the GDM - lacks the mathematical beauty of String Theory. It is simpler to describe a string than to describe a 3D wavepacket, but a day will come...

However, the GDM is isomorphic to reality, whereas String Theory remains pure Math.

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