

A **S**PACE**T**IME

**G**EOMETRO**D**YNAMIC **M**ODEL (GDM)

OF THE PHYSICAL REALITY

**Shlomo Barak**

# **The Book of the GDM**

**A Realization of Einstein's Vision**

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**A collection of 18 papers published Nov 2016 to Nov 2018.**

**A. Einstein (1933)**

.... the axiomatic basis of theoretical physics cannot be extracted from experience but must be freely invented...

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**This GDM book is a collection of 18 papers published from November 2016 to November 2018.**

## THE CURRENT PARADIGM

The current paradigm in physics, despite the successes of the excellent theories that construct it, is facing many obstacles. Many principles remain unproven, attributes of elementary particles cannot be derived and calculated, and mysteries are un-resolved. This situation results from the lack of a deeper theoretical layer.

## THE GDM

The missing theoretical layer is the GeometroDynamic Model (GDM) of reality. The GDM provides answers as to what are: **charge, elementary particles, inertia (mass), gravitation**, and relates to additional fundamental subjects. The GDM does not, at large, contradict the paradigm; it simply serves as a realistic and tangible deeper theoretical layer.

## GDM RESULTS

Some results, the **masses and radii of the elementary particles**, out of the many published in the Barak papers, are presented below. The Standard Model of elementary particles and String Theory, **wrongly** consider elementary particles to be alien to space, point-like or string-like, and structureless. This is why both theories **fail** to derive and calculate these masses and radii.

### Electron/Positron Mass

$$M_e = \frac{s^2 \sqrt{2}}{\pi(1 + \pi \alpha)} \cdot \sqrt{G^{-1} \alpha \hbar c^{-3}}$$

$$s = 1 \quad [s] = LT^{-1}$$

For the electron/positron charge, which is a white/black hole,  $s$  is light velocity at the event horizon, as the far-away observer measures [2].

$$M_e (\text{calculated}) = 0.91036 \cdot 10^{-27} \text{gr}$$

$$M_e (\text{measured}) = 0.910938356(11) \cdot 10^{-27} \text{gr}$$

A dimensionality check:  $[G^{-1}] = ML^{-3}T^2$   $[\alpha] = 1$   $[\hbar] = ML^2T^{-1}$   $[c^{-3}] = L^{-3}T^3$

Thus:

$$M = [s^2 \sqrt{G^{-1} \alpha \hbar c^{-3}}] = L^2 T^{-2} (ML^{-3} T^2 \cdot ML^2 T^{-1} \cdot L^{-3} T^3)^{1/2} = L^2 T^{-2} (M^2 L^{-4} T^4)^{-1/2} =$$

$$L^2 T^{-2} M L^{-2} T^2 = M$$

### Electron/Positron Radius

$$r_e (\text{calculated}) = 1.409858 \cdot 10^{-13} \text{cm}$$

### Muon/Anti-Muon Mass

$$M_\mu (\text{calculated}) = 112.5 \cdot \text{Mev}/c^2$$

$$M_\mu (\text{measured}) = 105.8 \cdot \text{Mev}/c^2$$

### Quarks/Anti-Quarks Masses

$$M_d \text{ (calculated)} = 9M_e = 4.5 \text{ MeV}/c^2$$

$$M_d \text{ (measured)} = 4.8 \pm 0.5 \text{ MeV}/c^2$$

$$M_{\bar{u}} \text{ (calculated)} = 4.5M_e = 2.25 \text{ MeV}/c^2$$

$$M_{\bar{u}} \text{ (measured)} = 2.3 \pm 0.8 \text{ MeV}/c^2$$

### Proton /Anti-Proton Charge Radius

$$r_p = \sqrt{2}/(2s^2) \cdot \sqrt{G\alpha\hbar c}$$

$$r_p \text{ (calculated)} = 0.8774 \cdot 10^{-13} \text{ cm}$$

$$r_p \text{ (measured)} = 0.8768(69) \cdot 10^{-13} \text{ cm}$$

### THE EXTENDED General Relativity (GR) EQUATION

By defining charge as nothing but curved space and using the Lorentz Transformation we derive the entire Maxwellian Electromagnetic theory, without any phenomenology. This result enables us [4] 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.

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

where  $S = 1$  and  $[S] = LT^{-1}$ . In the GDM  $[L] = \text{cm}$  and  $[T] = \text{sec}$ .

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, by the elementary spins, whereas charge is simply curved space. Charge and angular momentum are quantized and thus we predict that curvature of spacetime is also quantized. Thus, the creation or annihilation of pairs is supposed to result in a double quantum change in curvature.

## THE GDM IDEA

The elastic and vibrating three-dimensional Space Lattice **is all there is**.

Elementary particles are Transversal or Longitudinal wavepackets of this vibrating space.

## THE GDM METHOD OF UNIFICATION

The GDM approach to the issue of unification, see [17], is as follows: **Instead** of adding spatial 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 spacetime**, since in the GDM **space is all there is**. Thus, Riemannian geometry, applied to deformed spaces rather than to bent manifolds, see [6], becomes our mathematical tool to explore the reality.

## THE GDM GOALS

The GDM is a model of the physical reality, in which space is all there is.

This expresses the drive to reductionism.

The GDM explains known, but currently unexplained, phenomena.

This expresses the drive to understand.

The GDM predicts new phenomena that can be confirmed experimentally.

This is the requirement for specificity and falsifiability.

The GDM logically infers laws of physics.

No phenomenology and hence no need to ask where the laws come from.

## THE CONSTANTS OF NATURE

$c_T = c$     Velocity of transversal Space vibrations (EM waves)     $[c_T] = LT^{-1}$

$[c_L]$     Velocity of longitudinal Space vibrations ( $c_L > c_T$ )     $[c_L] = LT^{-1}$

$\hbar$     Planck Constant     $[\hbar] = L^5 T^{-1}$

$G$     Gravitational Constant     $[G] = T^{-2}$

$\alpha$     Fine Structure Constant     $[\alpha] = 1$

Since  $c_L/c = \pi/2 \cdot (1 + \pi \alpha)$ , see equation (25) in [2], we exclude  $c_L$  from the list and choose the known  $\alpha$  instead.



In the GDM the elastic space vibrates transversely and/or longitudinally.

Longitudinal electromagnetic waves have recently been detected, see [15].

In the GDM **there is no rest** - only motion at the waves' velocities.

Elementary particles at “**rest**” are circularly rotating wavepackets. Their virtual geometric centers are at rest. When they move the wavepackets describe spirals.

A Constant of Nature is a physical quantity that, measured locally by observers anywhere in space, and with any relative velocity with respect to each other and to space, results in the same value (invariance).

Note that a Constant of Nature is not necessarily regarded as a constant by an observer that observes other regions of space rather than his own. Our discussions on light velocity, both in SR and GR, will clarify this statement.

## THE UNITS OF THE GDM

In the GDM all units are expressed by the unit of length L (**cm**) and the unit of time T (**sec**) only. A conversion from the **GDM system** of units to the **cgs system** enables calculations of known phenomena and of new, GDM-predicted, phenomena.

## DIMENSIONALITY SEE [1], [2], [3], AND [4]

### esu

$$[M] = M$$

$$[Q] = Q$$

$$[H] = 1$$

$$[G] = M^{-1}L^3T^{-2}$$

$$[V] = LT^{-1}$$

$$[a] = LT^{-2}$$

$$[F] = MLT^{-2}$$

$$[\phi_E] = QL^{-1}$$

$$[\phi_G] = L^2T^{-2}$$

$$[E_E] = QL^{-2}$$

$$[E_G] = LT^{-2}$$

$$[U_M] = ML^2T^{-2}$$

$$[U_E] = Q^2L^{-1}$$

### GDM

$$[M] = L^3$$

$$[Q] = L^3$$

$$[H] = T^{-2}$$

$$[G] = T^{-2}$$

$$[V] = LT^{-1}$$

$$[a] = LT^{-2}$$

$$[F] = L^4T^{-2}$$

$$[\phi_E] = L^2$$

$$[\phi_G] = L^2$$

$$[E_E] = LT^{-2}$$

$$[E_G] = LT^{-2}$$

$$[U_M] = L^5T^{-2}$$

$$[U_E] = L^5T^{-2}$$

$$[\epsilon] = L^2 T^{-2}$$

## ORDER OF READING

As your entry point we suggest paper [1]. Then browse through the book, and explore first those papers that discuss subjects with which you are familiar. Paper [15] presents the GDM in detail.

## THE CONTENT OF THIS BOOK (Barak Papers)

### The essence of electric charge:

- [1] S. Barak: On the Essence of Electric Charge, Part 1: Charge as Deformed Space hal-01401332 (Nov 2016)

<https://hal.archives-ouvertes.fr/hal-01401332>

### A derivation and calculation of the elementary particles masses:

- [2] S. Barak: On the Essence of Electric Charge, Part 2: How Charge Curves Space hal-01402667v2 (Nov 2016)

<https://hal.archives-ouvertes.fr/hal-01402667>

### The nature of inertia (mass is merely a practicality) and free fall:

- [3] S. Barak: On the Essence of Gravitation and Inertia, Part 1: Inertia and Free Fall of an Elementary Particle

hal-01404143v5 (Nov 2016)

<https://hal.archives-ouvertes.fr/hal-01404143v5>

### The unification of gravitation and electromagnetism:

- [4] S. Barak: On the Essence of Gravitation and Inertia, Part 2:  
The Curving of Space by an Elementary Particle

hal-01405460 (Nov 2016)

<https://hal.archives-ouvertes.fr/hal-01405460>

### The strong force is electromagnetic:

- [5] S. Barak: Where is Anti-Matter? hal-01423547 (Dec 2016)

<https://hal.archives-ouvertes.fr/hal-01423547>

### Dark Matter as a misconception:

- [6] S. Barak: A Theoretical Derivation of the Milgrom MOND  
Equation hal-01471151v4 (Apr 2017)

<https://hal.archives-ouvertes.fr/hal-01471151v4>

### The photon and the quantum enigma:

- [7] S. Barak: The Photon and the Quantum Enigma hal-01423548  
(Dec 2016)

<https://hal.archives-ouvertes.fr/hal-01423548>

### The electron and the quantum enigma:

- [8] S. Barak: The Electron and the Quantum Enigma

hal-01631624 (Nov 2017)

<https://hal.archives-ouvertes.fr/hal-01631624>

### Quantization of Gravitation:

- [9] S. Barak: The Graviton hal-01524355 (May 2017)

<https://hal.archives-ouvertes.fr/hal-01524355>

### The GDM geometry:

- [10] S. Barak: On Curved Manifolds and Deformed Spaces

hal-01498435 (May 2017)

<https://hal.archives-ouvertes.fr/hal-01498435>

### On time (SR):

- [11] S. Barak: Time is not Fundamental - unlike Distance and Velocity. hal-01502214 (Apr 2017)

<https://hal.archives-ouvertes.fr/hal-01502214>

### Space as a special frame (SR):

- [12] S. Barak: Space as a Special Frame and Starlight Aberration  
hal-01498454 (Mar 2017)

<https://hal.archives-ouvertes.fr/hal-01498454>

### A Modification of SR:

- [13] S. Barak : The Constancy of One-Way Light Velocity and the  
Possibility that Space is a Foamy Fluid

hal-01625000v2 (Sep 2018)

<https://hal.archives-ouvertes.fr/hal-01625000v2>

### Electromagnetism; a continuation of [1]:

- [14] S. Barak: Electromagnetism as the Geometrodynamics of  
Space

hal-01498448(Mar 2017)

<https://hal.archives-ouvertes.fr/hal-01498448>

### The GDM:

- [15] S. Barak: A GeometroDynamic Model (GDM) of Reality

A Realization of Einstein's Vision hal-01435685v4 (Sep 2017)

<https://hal.archives-ouvertes.fr/hal-01435685v4>

### On space density as the variable of equations of physics:

[16] S. Barak: Equations of Physics and Space Density

hal-01625004 (Oct 2017)

<https://hal.archives-ouvertes.fr/hal-01625004>

### On methods of unification:

[17] S. Barak: The GeometroDynamic Model (GDM) Versus  
String Theory (ST) hal-01524356 (May 2017)

<https://hal.archives-ouvertes.fr/hal-01524356>

### The GDM in simple words:

[18] S. Barak: The GeometroDynamic Model (GDM) of Reality in  
80 THESES A Realization of Einstein's Vision hal-01524357v2  
(Sep 2017)

<https://hal.archives-ouvertes.fr/hal-01524357>

## BARAK PAPERS ON PHYSICS

The papers can be found by inserting Shlomo Barak in the HAL Search:

HAL (<https://hal.archives-ouvertes.fr/>)

# THE 80 GDM THESES appears also in [18]

## GDM Basics

**1.** The GDM sole **postulate** is:

**The three-dimensional elastic space is all there is.**

Necessarily:

The deformation of space is described by a metric.

Space vibrates longitudinally and transversally with only two corresponding velocities.

There is no rest - only motion at the waves' velocities.

Elementary particles at “rest” are circularly rotating wavepackets. Their virtual geometric centers are at rest. When they move the wavepackets describe spirals.

The only one field in the GDM is the tension in space, due to a gradient in space density, see 7.

**2.** In contrast to the conventional scientific **inductive method** the GDM is a

*freely invented* (Einstein's expression) idea. With this idea alone, we can

infer logically the laws of physics and construct a physical theory

isomorphic to the entire physical reality. The GDM is thus a non-

phenomenological theory.

The GDM specificity is expressed by new suggested experiments and

observations, which enable its “validation” or falsification.



**3.** In the past, space was considered a reference frame, which is meaningless without the presence of material bodies. Today, space is considered a kind of elastic foam or fluid elastic foam with nonlinear properties.

**4.** In the GDM **nothing is alien to space**. Space, not yet clearly modeled, is the **one and only one** basic physical entity that is needed to construct known physics and beyond.

**5.** The goal in physics is much humbler than finding the truth - what is truth? In physics we just build tentative models for different aspects of the Reality or for the entire Reality.

**6. A model:** A collection of mathematical equations and a description, geometrical or other, that relates to variables and constants.

**7.** In the GDM there is **only one variable**, which is **space density  $\rho$** . And only two dimensions: L length (cm) and T time (sec).

This space density  $\rho$ , of the foamy space lattice, is the number of space cells per unit volume,  $[\rho] = L^{-3}$ .

The un-deformed (contracted or dilated) space density is notated  $\rho_0$ .

Examples are:

**Electric Charge density:**  $q = 1/4\pi \cdot (\rho - \rho_0)/\rho$   $[q] = 1.$

Charge bivalency is clearly noticed.

**Curvature** of a deformed space, analogous to a bent manifold:

$$K = \frac{4\pi}{45} \left( \frac{\nabla \rho}{\rho} \right)^2$$

$$[K] = L^{-2}$$

**8.** The purpose of a model is:

To create a compact language to describe phenomena – Reductionism

To describe causal relationships - Understanding

To predict phenomena that have not yet been observed – Specificity

and Test of “Validity”

**The GDM expresses Ultimate Reductionism.**

**9.** English is our language. Tensor analysis and Riemannian geometry are our mathematical tools. Limitations of language and mathematics are also the limitations of a model, the GDM included.

**10.** Physical models are **tentative**. Even a single fact that the model cannot comply with falsifies the model.

## Riemannian Geometry

**11.** Riemannian geometry is the geometry of a n-dimensional **bent manifold**, in a hyperspace with additional dimensions. According to the GDM, it is also the geometry of a n-dimensional **deformed space**.

Hence, the metric of a 3D space zone can be regarded as the metric of a deformed elastic space that occupies this zone. This duality - bent versus deformed - enables us to understand General Relativity (GR) intuitively, and inspires our imagination.

**12.** Space in GR is considered a continuous manifold, bent (curved) by energy/momentum. Both Einstein (1933) and Feynman (1963), however, considered the option of space being a deformed (curved) continuum rather than a bent (curved) continuous manifold. In the GDM, though, space is a 3D **deformable entity** rather than a bent continuous manifold.

## On Space and Time in SR

**13.** In the theory of Special Relativity (SR) space is considered a **subjective** entity. An observer in an inertial frame observes space and bodies in another inertial frame moving relative to the first frame to be contracted a Lorentz-contraction. In the GDM space is objective and Lorentz-contraction, for Real velocities (**64, 65**) is real.

**14.** In SR time is also considered a **subjective** entity. An observer in an inertial frame observes “time” and clock rates in another inertial frame moving relative to the first frame to be Larmor-dilated. In the GDM clock rates are **objective** and for Real velocities Larmor-dilation (**64, 65**) is real.

### Spacetime in the Paradigm

**15.** If, however, we do not relate to space and time as independent entities, but as a combined (united) entity named **spacetime**, the reality returns to be **objective and absolute**. This is a result of the **Interval** being invariant to Lorentz transformation.

The idea of spacetime is beautiful but is merely a useful mathematical concept, since time, according to the GDM, is not a fundamental attribute of nature.

### Time in the GDM

**16.** **Distance and time** are considered fundamental attributes of the reality and the result of their division is velocity. We consider, in contrast, **distance and velocity** as fundamental and **time as merely a practicality**.

**17.** We do not know what time is, we only know what motion is.

We can build devices called clocks; whose hand movement (or whatever is analogous to the hand movement) describes the “passing of time”. Each cycle of the clock’s rhythm, or frequency of its motions, represents a unit of time. As a result, we consider spacetime to be merely a mathematical tool.

### **The Constant Light Velocity and the Fluid Space**

**18.** Measurements of **one-way** light velocity, along a given distance, in different directions in space, and using different techniques, yield the same result.

**19.** Electromagnetic waves, like gravitational waves, are according to GDM, space waves. In the paradigm, however, they have their own “media”, which according to General Relativity (GR) follows the topology of space. The isotropy obtained (**18**) is explained by the measurement instruments being stationary relative to space, and hence to the “media”. This is possible if space is confined locally by the Earth and carried along by its linear and rotational motions. This should also be the case for other planets and stars. Thus, to maintain continuity, space must be an **elastic fluid**.

**20.** Einstein in his paper (1939) on *stationary systems*, a term that appears in the second postulate of his Special Relativity (1905), identifies these systems as stars, and concludes that space must be a *compressible fluid*, carried by

these stars.

This carrying of space by Earth is accompanied by both rotational and linear Frame Dragging, which has been confirmed experimentally.

Thus, each star, the Earth included, is a **local frame**. To the CMB (Cosmological Microwave Background) frame we can relate as the **global frame** for the entire space.

**21.** Based on theses **18** to **20** the GDM modifies textbook's Special Relativity (SR). See theses **59** to **66**

## **Transversal and Longitudinal Space Waves**

**22.** The elastic space vibrates transversely and longitudinally. Gravitational waves are transversal **space** waves that recently have been detected (2016).

EM waves are also, according to the GDM, transversal **space** waves. Note, however, the recent evidence, for the existence of longitudinal EM waves.

**23.** The GDM, reveals the relation between:

$c_T = c$  Velocity of transversal Space vibrations (EM waves), and the

$c_L = \pi/2 \cdot (1 + \pi \alpha) \cdot c$  Velocity of longitudinal Space vibrations ( $c_L > c_T$ )

$c_L = 1.6068 \cdot c$ , where  $\alpha$  is the Fine Structure Constant.

This relation is a key element in our model of the elementary particles.

## Electric Charge and Electromagnetism

**24.** Charge is not alien to space; it is a drastically curved zone of space. Contracted space is **positive charge** whereas dilated space is **negative charge**.

Current theories are unable to derive the attributes of electric charge, which are: bivalency, stability, quantization, equality of the absolute values of the bivalent charges, the electric field it creates and the radii of the bivalent charges. The GDM derives it all.

**25.** Electric charge density is defined based on space density only. This definition alone, without any phenomenology, yields the theory of Electrostatics. Together with the Lorentz Transformation it yields, as an approximation, the entire Maxwell Electromagnetic theory. The **non**-approximated theory is **non**-linear, since the field is part of the charge that creates it - like in gravitation. This is the specificity of the theory that resembles QED.

## The Masses of Elementary Particles

**26.** The GDM model of the electric charge and its field enables us, for the first time, to derive simple equations for the radii and masses of the electron/positron muon/anti-muon and that of quarks/anti-quarks. These equations contain only the constants  $G$ ,  $c$ ,  $\hbar$  and  $\alpha$  (the fine structure constant). The calculated results based on these equations comply with the experimental data of CODATA 2014.

**27.** The Standard Model of elementary particles and String Theory, **wrongly** consider elementary particles to be alien to space, point-like or string-like, and structureless. This is why they **fail** to derive and calculate these masses and radii.

## Gravitation

**28.** Masses of elementary particles curve space positively. They also sense (are affected by) curvature, created by other masses, and move accordingly. How this occurs, and what is inertia are open issues in the paradigm. The GDM elementary particle model resolves these issues, shows **mass** to be merely a practicality, and proves Newton's First and Second Laws.

**29.** The contraction (curving) of space by a mass (GR's gravitation) creates a gradient in light velocity. A particle, retaining its angular momentum, senses this gradient, and is forced into **free fall**. This free fall is attributed to the **currently unexplained** attraction between masses. The GDM proves Newton's Law of Gravitation and the equivalence of gravitational and inertial masses.

**30.** The spin of an elementary particle causes space torsion. This torsion results in space contraction (positive curving), which is GR's gravitation. Knowing how spin and charge curve space, we extend Einstein's field equation to become an equation of both energy/momentum and charge/current. This equation becomes a macroscopic/microscopic equation of the physical reality. Charge and angular momentum are quantized and thus curvature of spacetime, on the microscopic level, should also be quantized.



## Quarks, Strong Force and the Issue of Where is Anti-Matter

**31.** The GDM shows that in the universe, the amount of matter exactly **equals** the amount of anti-matter. This suggests (see **36**) that creation started in a Pair - production process.

**32.** We model a quark (anti-quark) as a topologically twisted positron (electron), which is a circulating longitudinal wavepacket of space contraction (dilation) namely positive charge (negative charge). This explains confinement, and enables us to derive and calculate the masses of the d and u quarks, and the radius of the proton charge. Our results comply with the experimental data of CODATA 2014. It also enables us to prove that the **strong force** is an electromagnetic force.

**33.** Mesons, baryons, protons and neutrons are made of quarks and hence are made of electrons and positrons. By showing that **neutral atoms are constructed of an equal number of electrons and positrons**, we prove that the amount of matter in the universe exactly **equals** the amount of anti-matter.

## The Photon and the Photom

**34.** The GDM models the Photon as an oscillation of the space lattice, in a plane perpendicular to its line of propagation at the light velocity  $c$ . This plane is vertical or horizontal or rotating clockwise or anti-clockwise. The Photon oscillation occupies a finite volume of space with a defined shape, structure and size. The size is proportional to the photon's wavelength.

**35.** In the GDM contracted space is positive charge and dilated space is negative charge. The photon is a space oscillation of contraction and dilation on opposite sides of the line of propagation. Thus, **the photon is a confined oscillating dipole with its resultant field.**

**36.** This dipole is an oscillation of the **bivalent elementary charges**, which in the pair production process are **converted** into the stable bivalent elementary charges of the electron and positron (as it is for other elementary particles).

Transversal to longitudinal **mode conversion** is a known process.

**The photon in the GDM holds all the basic features that appear in all the other elementary particles.**

**37.** QED attributes to a photon in its ground state half of the photon energy, half of its linear momentum, and half of its spin. To distinguish a photon from a ground state photon, we name it a **Photom**, which is a “photon at the bottom”.

In the GDM the “oscillating dipole” photon “splits” into two types of photoms:

**The Positive Photom:** An oscillating contraction of space (positive charge), close to the line of propagation. This oscillation is in a plane or in a rotating plane, around the line of propagation.

**The Negative Photom:** An oscillating dilation of space (negative charge) close to the line of propagation. This oscillation is in a plane or in a rotating plane, around the line of propagation.

**38.** The GDM considers these photoms as the “electron” and “positron” pair of the **Dirac Sea**. Vacuum polarization is due to this Dirac Sea. This way we dispel the need for separate ground states (vacuum states) for the EM field and for the electron and positron field (Dirac sea). And since all the forces in the GDM are one force, all the ground states are the one, and only one, **Dirac Sea**.

## **The Photon Quantum Enigma**

**39.** Ensembles of photons and photoms, in order to reach a lower state of energy, condense when they are in-phase and disperse when in anti-phase.

Ensembles of closely packed photons or photoms, which oscillate in phase, are the classical EM waves.

Photons of intersecting anti-phased beams are not destroyed - they are **displaced**.

This feature explains the double-slit experiment, for an **ensemble** of photons or photoms (classical EM waves).

**40.** **Spontaneous** emission of a photon is **induced emission** by a photom. The density of photoms (the number of space vibrational modes per unit volume) is so high that they condense to create classical waves. This explains the double-slit experiment for **single** photons. Thus, the GDM **dispels** the need

for attributing a **dualistic nature** to single photons that arrive at the screen one at a time.

## The Graviton

**41.** Gravitational waves have recently been detected. These space waves are predicted by General Relativity. As of today, there is no theoretical proof, or observational evidence, for the existence of quanta of these waves.

**42.** The GDM models the, as yet hypothetical, Graviton. The argument in support of its existence is that gravitation is quantized, **30**.

## The Electron (Positron)

**43.** In the GDM every space disturbance - a transversal or longitudinal wavepacket - must move at the velocity  $c_T$  or  $c_L$ , respectively. “Rest” is the case in which a wavepacket moves in a closed loop.

**44.** The **electron (positron)** at “rest” is a circulating longitudinal dilational (contractional) wavepacket (its charge) with radius  $r_0$ . Its tangential velocity of propagation is  $c$  and its radius of circulation is  $R_0$ . This circulation (which is not just a simple circle) is the **origin of spin**. Thus, from a distance, the electron (positron) is observed as if at rest, and from close, as a volumetric dilation (contraction), which is its negative (positive) charge that moves in a circle. This

circulation creates the electron magnetic moment, which the GDM calculates classically.

**45.** In linear motion, at velocity  $v$ , the circle of revolution becomes a spiral. The length of the wavepacket is retained, hence the spiral radius shrinks  $R < R_0$  (in analogy to a stretched spring) and also  $r < r_0$ . Thus:  $R = 1/\gamma \cdot R_0$  and also  $r = 1/\gamma \cdot r_0$ . The GDM shows that  $r/R = \alpha$  the fine structure constant.

From this alone we derive the **results** of the **GDM Special of Relativity**.

**46.** The **resultant** electron motion, however, is **always** at the wave velocity  $c$ . Thus, a translatory motion at constant velocity  $v$ , does not involve any exertion of force. It is also obvious that necessarily  $v < c$ . **Newton's first law**, and the **second postulate of the theory of relativity**, which implies that no particle or signal can move at a speed that exceeds the light/wave velocity  $c$ , are thus a natural result of the GDM.

**47.** The force to accelerate an electron is needed to curve space more strongly by reducing  $r$  (hence increasing the energy). **Newton's Second Law** and **Inertia** are thus explained.

**48.** In the paradigm, the **kinetic energy**  $\frac{1}{2}M_0v^2$ , which a particle possesses by virtue of its motion, is distinguished from the **internal energy**  $M_0c^2$ . In the GDM, however, the kinetic energy is also an internal energy of deformation (the reduction in sizes of  $r$  and  $R$ ) that cannot be distinguished from the rest energy. Thus, **mass** is only a **practical term**.

### **The Electron Quantum Enigma**

**49.** The wavefunction with the electron's linear momentum  $P$  and kinetic energy  $U_k$ , gives the **probability amplitude** of the electron to be in a specific location at a specific time. This wavefunction borrows its features from those of the electron wavepacket. The wavefunction is associated with a real EM wave, generated by the electron, which creates a space permittivity wave of photoms. This permittivity wave, which moves ahead at the speed of light, guides the electron and gives the wavefunction its predictive probabilistic nature.

**50.** In the double-slit experiment, this EM wave creates the interference pattern that spatially modulates the permittivity of space. We assume that this pattern is retained for some time, determined by a relaxation time **not known to us**. This time interval should be at least the time for the electron to move from the slit to the screen.

## **“Dark Matter”**

**51.** Based on General Relativity, we derive theoretically, the Milgrom phenomenological MOND equation that explains Rotation Curves in galaxies. This is made possible by considering the inhomogeneous space expansion - Hubble flow, in and around, galaxies. Our derivation dispels the need for Dark Matter, or modifications of accepted physics.

## **Foundations of Physics:**

**52.** 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 microscopic interactions.
- E.** A Unifying Foundation, that unifies the above four foundations, attempts to present the three forces of nature, electromagnetic, gravitational, and strong force, as one.

The GDM is a unifying foundation.

## GDM versus String Theory and Unification

**53.** The axiomatic 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 Elementary Particles (EP), **which in ST are strings alien to space**. ST leaves important issues open, and does not suggest experiments to “verify” or falsify its contentions.

**54.** The 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.

**55.** The GDM serves as an underlying theory to the four basic foundations and does not require any new mathematics or **extra dimensions**.

The elastic **3D space** is all there is; this GDM single postulate gives it all.

## GDM Equations and Their Single Variable

**56.** In the GDM the “hidden” variable of the **Navier, Maxwell, Einstein and Ricci Flow equations** is  $\rho$  - the space lattice density. In the GDM, sources are merely highly deformed zones of space (highly contracted or dilated) whereas their fields are continuations of these deformations, reduced by orders of magnitude, with only a small deviation from the normal (standard) space density. Thus, the equations express different aspects of the same reality - the geometrodynamics of space.



**57.** The electron wavefunction, which is the solution of **Schrodinger's Equation**, is associated with a real space permittivity wave of photoms generated by the electron. This idea proves the de Broglie conjecture. Note that permittivity is also  $\rho$  dependent and so is the Schrodinger Equation.

**58.** This space permittivity wave of photoms, created by the electron and moving ahead of it, guides the electron to create the interference pattern in the double-slit experiment.

### **Modified Special Relativity (MSR) See 18 to21**

**59.** In MSR - GDM Modified SR - the first SR postulate is turned into a definition of the term: A **Law of Nature**.

**Definition:** A physical law is a **law of nature** if it appears the same in all inertial systems.

**60.** Instead of SR **postulates** MSR presents **laws**:

**First Law:** Rays of light move in a “stationary” system with velocity  $c$ , relative to this system, whether the rays are emitted by a stationary or by a moving body. Note that all stars are “stationary” systems. But **it is not clear** how small a material system can be and still serve as a “stationary” system.

**61. Second Law:** Real velocity of an inertial system (velocity relative to the “stationary” system in which the inertial system resides) is accompanied by a real Lorentz contraction of material bodies and a real Larmor slowing-down of clocks in this system.

**62.** Two inertial material systems, moving at the same  $\mathbf{v}$ , cannot be considered as one combined inertial system, as argued by J. Bell, since space between them is not affected.

**63.** Space between galaxies is subjected to the Hubble flow whereas the space inside galaxies is not (no cosmological redshift). The CMB resides in the **global** space in and around galaxies and its frame defines real velocity relative to the **global** space.

A **local** “stationary” space is that of any star, the Earth included.

## On Relative and Real Velocities

**64. Relative** velocity is the velocity between any two inertial systems.

**Real** velocity is the velocity of an inertial system relative to a “stationary” system - global or local.

Real velocity is accompanied by real length contraction and time dilation (the slowing of clocks).

If we only consider relative velocities, length contraction and time dilation are **not real**, as argued by Born.

## **Lorentz Contraction and Larmor Time Dilation**

**65. Lorentz contraction** is related to material bodies, and **might** also relate to local spaces. It is determined by real velocity as suggested by Lorentz (1904), and the GDM.

**Larmor time dilation** is the slowing rate of clocks, and is determined by real velocity (note that we do **not** consider time to be fundamental).

## **Simultaneity**

**66.** We can infer real velocities of inertial frames, by measuring our own real velocity, and our relative velocities to the other frames. Thus, internal observers of all frames will agree whether events occur at the same time or not, despite the fact that their clock rates might differ. **Simultaneity is thus absolute**, in contrast to textbook SR in which it is relative.

## **General Relativity (GR) Unification and Quantization**

**67.** Riemannian geometry, the mathematical basis of GR, is the geometry of a n-dimensional **bent manifold**, in a hyperspace with additional dimensions. According to the GDM, it is also the geometry of a n-dimensional **deformed space** (see 11). Hence the metric of a 3D space zone can be regarded as the metric of a deformed elastic space that occupies this zone.

**68.** Consider the linear dimension of a space cell as the local observer's yardstick. Hence, in a space lattice the distance between two points is simply the number of space cells on the straight line between the two points for a Euclidian space and on the geodesic for a Riemannian (deformed) space.

**69.** We consider a **standard unit of length** to be a yardstick with **the same number** of space cells along its length, anywhere in space. A one-centimeter yardstick, for example, contains the same number of space cells anywhere. The linear dimensions of these cells, however, might vary in different zones of space, according to their densities. Hence, the length of the yardstick, as seen by observers in different zones of space, may also vary.

**70.** We consider a **standard unit of time** to be the time that it takes for a light beam to cross a standard unit of length. If the yardstick moves with respect to space, a unit of time is the time it takes for the beam to move back and forth, divided by two. This device is our **standard clock**.

**71.** Observers in all zones of space, regardless of their space densities, will claim to get the same result measuring light velocity with their standard yardsticks and clocks. Hence, we relate to light velocity as **a constant of nature**.

**72.** However, each and every far-away observer finds that, according to his measurements and understanding, light velocity elsewhere, where local-observers reside, might vary according to space density in their locality. This is the result of light velocity dependence on the permittivity and permeability of space, which is dependent on space density.

**73.** The permittivity and permeability of space depend on the density of space. Hence, we should **not** consider light velocity as a constant. We, thus, relate to the “**coordinate speed of light**” of GR as a real speed.

**74.** An elementary particle has an additional mechanism by which it contracts space around itself (creates positive curvature) besides its direct contraction or dilation of space, related to its charge. This contraction is related to its energy content. This mechanism of contraction, is due to the torsion in space created by the spin of the elementary particle, and hence related to its **inertial mass**.

**75.** A longitudinal wavepacket applies pressure on the space lattice and bends its sides perpendicular to the wavepacket circular/linear propagation direction. This bending is “Frame Dragging” and causes the contraction of space around a circulation track. As a result, particles have this additional minute positive curvature that depends on their Angular Momentum.

**76.** All this proves that **gravitational mass is inertial mass**; a stronger statement than the **equivalence principle**.

**77.** By defining charge as 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 ( $T_q^{\mu\nu}$ ).

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

where  $S = 1$  and  $[S] = LT^{-1}$

**78.** Charge and angular momentum are quantized and thus, we predict that the curvature of space is also quantized.

**79.** This extended equation (**77**) becomes a macroscopic/microscopic equation of the **entire physical reality**.

### **S. Hawking (1987)**

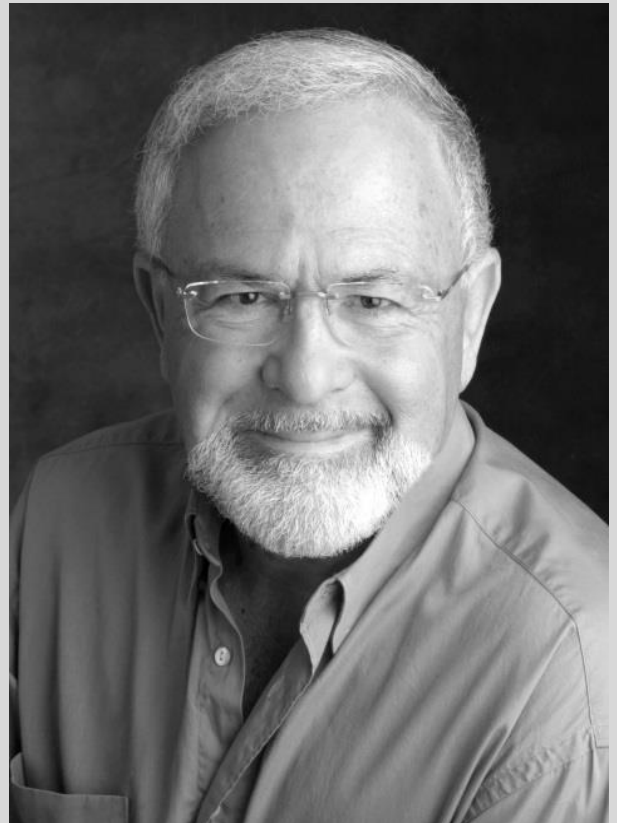
**80.** *However, if we do discover a complete theory... Then we shall ... take part in the discussion of the question of **why it is that we and the universe exist**. If we find the answer to that, it would be the ultimate triumph of human reason.*

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**Dr. Shlomo Barak**

## Some GDM Results

### Electron/Positron Mass

$$M_e = \frac{s^2 \sqrt{2}}{\pi(1 + \pi \alpha)} \cdot \sqrt{G^{-1} \alpha \hbar c^{-3}}$$

$$s = 1, [s] = \text{LT}^{-1}$$

$$M_e (\text{calculated}) = 0.91036 \cdot 10^{-27} \text{gr}$$

$$M_e (\text{measured}) = 0.910938356(11) \cdot 10^{-27} \text{gr}$$

### Proton/Anti-Proton Charge Radius

$$r_p = \sqrt{2}/(2s^2) \cdot \sqrt{G \alpha \hbar c}$$

$$s = 1, [s] = \text{LT}^{-1}$$

$$r_p (\text{calculated}) = 0.8774 \cdot 10^{-13} \text{cm}$$

$$r_p (\text{measured}) = 0.8768(69) \cdot 10^{-13} \text{cm}$$

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