Discovery after 109 Years of Einstein Theory of Gravity

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Absolute Unified Mathematics of Quantum Gravitation

Aayush Sinha[1], [1]Indian Youth Nuclear Society, India

aayushofficialcontact@gmail.com

INTRODUCTION

"Absolute Unified Mathematics of Quantum Gravitation", offers a complete solution to the following existence problems in both mathematics and physics. These includes: (I) Unification of Quantum Physics and General Theory of Relativity ; (II) Complete solution to Einstein Curvature Tensor, "$R_{ij} = \frac{8\pi G}{c^4}\left(T_{ij} - \frac{1}{2}g_{ij}T\right)$"; Ricci Curvature Scalar, "R"; Ricci Tensor, "R_{ij}", and Riemann Curvature Tensor, "R^{α}_{ijk}"; (III) Unification of all Spacetime Geometries, under the unified equation: "$-\left(-\int_M \left(\left(\mathrm{Tr}(R_{ij})\right) < 0\right) dV\right) = \left(-\int_M \left(\left(\mathrm{Tr}(R_{ij})\right) = 0\right) dV\right) - \left(-\int_M \left(\left(\mathrm{Tr}(R_{ij})\right) > 0\right) dV\right)$"; (IV) Complete solution to Ricci Flow and Singularity; (V) Dark Energy and Flatness Problem; (VI) Completeness of Geodesic equation; (VII) Coordinate Transformation of Quantum Fields; and (VIII) many more.

CONCLUSION & FUTURE SCOPE

In this mathematical framework, I have concluded the root characteristics of Quantum Gravitation. These are elucidated through skew-symmetric and symmetric quantum fields, which are found embedded within Ricci curvature tensor and Ricci curvature scalar, as shown here. These fields have emerged from a generalized solution, as demonstrated by equations (3), (4), (5), (6), (7) and (8). As a result, the following underlying components of RICCI CURVATURE TENSOR, "R_{ij}", were discovered :

(a) DIRAC EQUATIONS of type:

$$\frac{\partial\gamma^\alpha}{\partial x^\alpha}\gamma^m\gamma_i\left(\frac{\partial\gamma_m}{\partial x^j}-\frac{\partial\gamma_j}{\partial x^m}\right) = \partial_\alpha\gamma^\alpha\gamma^m\gamma_i\partial_j\gamma_m - \partial_\alpha\gamma^\alpha\gamma^m\gamma_i\partial_m\gamma_j,\quad \frac{\partial\gamma^\alpha}{\partial x^\alpha}\gamma^m\left(\frac{\partial\gamma_m}{\partial x^j}-\frac{\partial\gamma_j}{\partial x^m}\right)\gamma_i = \partial_\alpha\gamma^\alpha\gamma^m\partial_j\gamma_m\gamma_i - \partial_\alpha\gamma^\alpha\gamma^m\partial_m\gamma_j\gamma_i,\ \text{etc.};$$

(b) QUANTUM GRAVITATIONAL WAVES

(second-order partial derivatives of GAMMA MATRICES or BASIS VECTORS) of type:

$$g^{\alpha m}\gamma_i\frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^j} = g^{\alpha m}\gamma_i(\partial_\alpha\partial_j\gamma_m),\quad g^{\alpha m}\frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^j}\gamma_i = g^{\alpha m}(\partial_\alpha\partial_j\gamma_m)\gamma_i,$$

etc. ; for describing concavity and convexity of 'R_{ij}' in $\mathbb{R}^4$ dimensions.

FUTURE SCOPE: I proposed the followings:

(I) A QUANTUM COMPUTING SOFTWARE INTEGRATED WITH ARTIFICIAL INTELLIGENCE, using these Absolute Unified Mathematics of Quantum Gravitation; for numerous futuristic industrial applications.

(II) A futuristic project of a HILL-CONTAINED, VERTICALLY POSITIONED GRAVITY DECELERATOR having spanning height of typical ~2,300 meters; for decelerating a beam of heavy ions or protons, as facilitated by Einstein's Gravity Flow "Spherical Curvature" : "$\left(-\int_M \left(\left(\mathrm{Tr}(R_{ij})\right) > 0\right) dV\right)$. This will experimentally confirm the followings:

(i) Dark Energy Flow – Phenomena of Space Dilation and Time Contraction;
(ii) Geodesic Divergence of heavy ions or protons (fountain effect);
(iii) Dark Energy Flow – Increase in Kinetic Energy of Hyperbolic Curvature, as illustrate in Fig. 1;
(iv) Einstein's Gravity Flow–Ordinary Matter interactions;
(v) Investigation of Dark Matter; and (vi) Emission of Gravitational waves.

METHODOLOGY : A GENERALIZED SOLUTION TO NON-LINEAR PDE's OF GENERAL RELATIVITY

To derive the embedded quantum fields within the non-linear function (CHRISTOFFEL), "$\Gamma_{ij,\,m}$", I started with a covariant differentiation, "∇_j", of a fundamental tensor, "g_{im}", as illustrated in equations (3) and (4) [1]. These equations are acquainted with first order COVARIANT DERIVATIVES of GAMMA MATRICES, "γ_i" and "γ_m". A brilliant physicist - Paul A. M. Dirac, first introduced these GAMMA MATRICES in his 1928 paper which also incorporates PAULI MATRICES within GAMMA MATRICES [2]. According to the CLIFFORD ALGEBRA, these matrices are also referred as the basis vectors of fundamental tensor, "g_{im}", and are fundamentally known by equations (1) and (2) [3].

$$\gamma_i\gamma_m + \gamma_m\gamma_i = 0\ ,\ i \neq m \tag{1}$$

$$g_{im} = \frac{\gamma_i\gamma_m + \gamma_m\gamma_i}{2} \tag{2}$$

$$\frac{\partial g_{im}}{\partial x^j} = \nabla_j\left[\frac{\gamma_i\gamma_m + \gamma_m\gamma_i}{2}\right] + g_{pm}\Gamma^p_{ij} + g_{ip}\Gamma^p_{mj} \tag{3}$$

$$\frac{\partial g_{im}}{\partial x^j} = \frac{1}{2}\left[\{\nabla_j\gamma_i\}\gamma_m + \gamma_i\{\nabla_j\gamma_m\} + \{\nabla_j\gamma_m\}\gamma_i + \gamma_m\{\nabla_j\gamma_i\}\right] + g_{pm}\Gamma^p_{ij} + g_{ip}\Gamma^p_{mj} \tag{4}$$

$$\frac{\partial g_{im}}{\partial x^j} = \frac{1}{2}\left[\left\{\frac{\partial\gamma_i}{\partial x^j} - \gamma_p\Gamma^p_{ij}\right\}\gamma_m + \gamma_i\left\{\frac{\partial\gamma_m}{\partial x^j} - \gamma_p\Gamma^p_{mj}\right\} + \left\{\frac{\partial\gamma_m}{\partial x^j} - \gamma_p\Gamma^p_{mj}\right\}\gamma_i + \gamma_m\left\{\frac{\partial\gamma_i}{\partial x^j} - \gamma_p\Gamma^p_{ij}\right\}\right] + g_{pm}\Gamma^p_{ij} + g_{ip}\Gamma^p_{mj} \tag{5}$$

$$\frac{\partial g_{jm}}{\partial x^i} = \frac{1}{2}\left[\left\{\frac{\partial\gamma_j}{\partial x^i} - \gamma_p\Gamma^p_{ji}\right\}\gamma_m + \gamma_j\left\{\frac{\partial\gamma_m}{\partial x^i} - \gamma_p\Gamma^p_{mi}\right\} + \left\{\frac{\partial\gamma_m}{\partial x^i} - \gamma_p\Gamma^p_{mi}\right\}\gamma_j + \gamma_m\left\{\frac{\partial\gamma_j}{\partial x^i} - \gamma_p\Gamma^p_{ji}\right\}\right] + g_{pm}\Gamma^p_{ji} + g_{jp}\Gamma^p_{mi} \tag{6}$$

$$-\frac{\partial g_{ij}}{\partial x^m} = -\frac{1}{2}\left[\left\{\frac{\partial\gamma_i}{\partial x^m} - \gamma_p\Gamma^p_{im}\right\}\gamma_m + \gamma_i\left\{\frac{\partial\gamma_j}{\partial x^m} - \gamma_p\Gamma^p_{jm}\right\} + \left\{\frac{\partial\gamma_j}{\partial x^m} - \gamma_p\Gamma^p_{jm}\right\}\gamma_i + \gamma_m\left\{\frac{\partial\gamma_i}{\partial x^m} - \gamma_p\Gamma^p_{im}\right\}\right] - g_{pj}\Gamma^p_{im} - g_{ip}\Gamma^p_{jm} \tag{7}$$

The first order covariant derivatives, "$\nabla_j, \nabla_i, \nabla_m$", of these fundamental tensor, "g_{im}, g_{jm}, g_{ij}", were shown in equations (5), (6) and (7) [4]. Further, I derived a torsion-free CHRISTOFFEL SYMBOLS OF SECOND KIND, "Γ^α_{ij}". This was pursued by substituting the above partial derivatives of fundamental tensors, "$\frac{\partial g_{im}}{\partial x^j}, \frac{\partial g_{jm}}{\partial x^i}, -\frac{\partial g_{ij}}{\partial x^m}$", as shown in equations (5), (6) and (7), into the known equation of "$\Gamma^\alpha_{ij} = \frac{1}{2}g^{\alpha m}\left[\frac{\partial g_{im}}{\partial x^j} + \frac{\partial g_{jm}}{\partial x^i} - \frac{\partial g_{ij}}{\partial x^m}\right]$" [1]. With further simplification, I have discovered equation (8) [1].

$$\Gamma^\alpha_{ij} = g^{\alpha m}\frac{1}{4}\left(\gamma_i\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)\gamma_i + \gamma_j\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_j + \gamma_m\left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right)\gamma_m\right) \tag{8}$$

It turns out that the equation (8), "Γ^α_{ij}", is a non-linear function, consists of one symmetric quantum field and two skew-symmetric quantum fields. In this equation, (i) the expression: "$\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)$" and "$\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)$" are skew-symmetric tensors (also known as curl of covariant vectors, "γ_i" and "γ_m"; or rotational tensor); and (ii) symmetric quantum field, "$\left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right)$", respectively. It is known that their are only four covariant GAMMA MATRICES $(\gamma_0, \gamma_1, \gamma_2, \gamma_3)$ [2]. Additionally, the last GAMMA MATRICES, "γ_5", also known as the fifth one, makes it possible to introduce Chirality within this generalized framework of quantum gravitation [2].

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AAYUSH SINHA
Author & Presenter

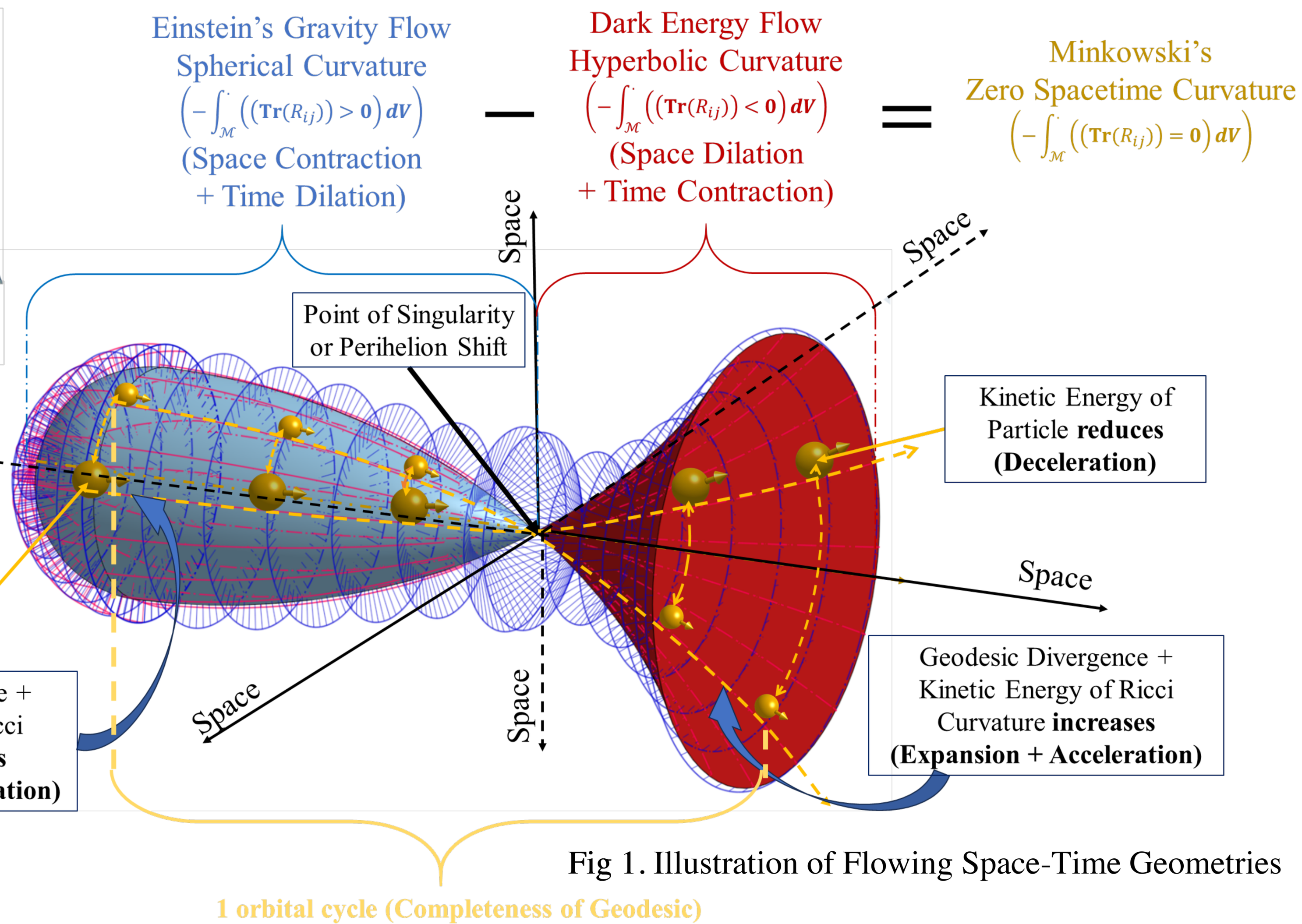

Fig 1. Illustration of Flowing Space-Time Geometries

UNIFICATION OF FLOWING SPACE-TIME GEOMETRIES

"DARK ENERGY FLOW" [Expansion & Acceleration of Ricci Curvature, "R_{ij}" (Space Dilation (Volume Expansion) + Time Contraction)] (HYPERBOLIC CURVATURE FLOW)

"MINKOWSKI'S FLAT SPACETIME FLOW" [Zero Ricci Curvature, "R_{ij}"]

"EINSTEIN'S GRAVITY FLOW" [Contraction & Deceleration of Ricci Curvature, "R_{ij}" (Space Contraction + Time Dilation (Expansion)] (SPHERICAL CURVATURE FLOW)

$$-\left(-\int_M \left(\left(\mathbf{Tr}(R_{ij})\right) < 0\right) dV\right) = \left(-\int_M \left(\left(\mathbf{Tr}(R_{ij})\right) = 0\right) dV\right) - \left(-\int_M \left(\left(\mathbf{Tr}(R_{ij})\right) > 0\right) dV\right)$$

Ricci Flow (Curvature Flow) [4] :

$$-\int_M (R)\,dV = -\int_M \left(g^{ij}R_{ij}\right) dV = -\int_M \left(\mathbf{Tr}(R_{ij})\right) dV$$

$$= -\int_M \left(\mathbf{Tr}\left(-\left[\!\left[\frac{\partial g^{\alpha m}}{\partial x^\alpha}\Gamma_{ij,m} + g^{\alpha m}\frac{\partial\Gamma_{ij,m}}{\partial x^\alpha}\right]\!\right] + \left[\!\left[\frac{\partial g^{\alpha m}}{\partial x^j}\Gamma_{i\alpha,m} + g^{\alpha m}\frac{\partial\Gamma_{i\alpha,m}}{\partial x^j}\right]\!\right] + \Gamma^\alpha_{\beta j}\Gamma^\beta_{i\alpha} - \Gamma^\alpha_{\beta\alpha}\Gamma^\beta_{ij}\right)\right) dV$$

EMBEDDED COMPONENTS OF RICCI CURVATURE TENSOR "$R_{ij} = \frac{8\pi G}{c^4}\left(T_{ij} - \frac{1}{2}g_{ij}T\right)$"

$$\frac{\partial g^{\alpha m}}{\partial x^\alpha}\Gamma_{ij,m} = \left[\!\left[\left(\frac{1}{8}\right)\left[\frac{\partial\gamma^\alpha}{\partial x^\alpha}\gamma^m + \gamma^m\frac{\partial\gamma^\alpha}{\partial x^\alpha} + \frac{\partial\gamma^m}{\partial x^\alpha}\gamma^\alpha + \gamma^\alpha\frac{\partial\gamma^m}{\partial x^\alpha}\right]\left[\gamma_i\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)\gamma_i + \gamma_j\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_j + \gamma_m\left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right)\gamma_m\right]\right]\!\right]$$

$$\frac{\partial g^{\alpha m}}{\partial x^j}\Gamma_{i\alpha,m} = \left[\!\left[\left(\frac{1}{8}\right)\left[\frac{\partial\gamma^\alpha}{\partial x^j}\gamma^m + \gamma^m\frac{\partial\gamma^\alpha}{\partial x^j} + \frac{\partial\gamma^m}{\partial x^j}\gamma^\alpha + \gamma^\alpha\frac{\partial\gamma^m}{\partial x^j}\right]\left[\gamma_i\left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right)\gamma_i + \gamma_\alpha\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_\alpha + \gamma_m\left(\frac{\partial\gamma_i}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^i}\right)\gamma_m\right]\right]\!\right]$$

$$g^{\alpha m}\frac{\partial\Gamma_{ij,m}}{\partial x^\alpha} = \left[\!\left[\left(\frac{1}{4}\right)g^{\alpha m}\left[\begin{aligned}&\frac{\partial\gamma_i}{\partial x^\alpha}\frac{\partial\gamma_m}{\partial x^j} + \gamma_i\frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^j} - \frac{\partial\gamma_i}{\partial x^\alpha}\frac{\partial\gamma_j}{\partial x^m} - \gamma_i\frac{\partial^2\gamma_j}{\partial x^\alpha\partial x^m} + \frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^j}\gamma_i + \frac{\partial\gamma_m}{\partial x^j}\frac{\partial\gamma_i}{\partial x^\alpha} - \frac{\partial^2\gamma_j}{\partial x^\alpha\partial x^m}\gamma_i\\ &- \frac{\partial\gamma_j}{\partial x^m}\frac{\partial\gamma_i}{\partial x^\alpha} + \frac{\partial\gamma_j}{\partial x^\alpha}\frac{\partial\gamma_m}{\partial x^i} + \gamma_j\frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^i} - \frac{\partial\gamma_j}{\partial x^\alpha}\frac{\partial\gamma_i}{\partial x^m} - \gamma_j\frac{\partial^2\gamma_i}{\partial x^\alpha\partial x^m} + \frac{\partial^2\gamma_m}{\partial x^\alpha\partial x^i}\gamma_j\\ &+ \frac{\partial\gamma_m}{\partial x^i}\frac{\partial\gamma_j}{\partial x^\alpha} - \frac{\partial^2\gamma_i}{\partial x^\alpha\partial x^m}\gamma_j - \frac{\partial\gamma_i}{\partial x^m}\frac{\partial\gamma_j}{\partial x^\alpha} + \frac{\partial\gamma_m}{\partial x^\alpha}\frac{\partial\gamma_i}{\partial x^j} + \gamma_m\frac{\partial^2\gamma_i}{\partial x^\alpha\partial x^j} + \frac{\partial\gamma_m}{\partial x^\alpha}\frac{\partial\gamma_j}{\partial x^i} + \gamma_m\frac{\partial^2\gamma_j}{\partial x^\alpha\partial x^i} + \frac{\partial^2\gamma_i}{\partial x^\alpha\partial x^j}\gamma_m + \frac{\partial\gamma_i}{\partial x^j}\frac{\partial\gamma_m}{\partial x^\alpha} + \frac{\partial^2\gamma_j}{\partial x^\alpha\partial x^i}\gamma_m + \frac{\partial\gamma_j}{\partial x^i}\frac{\partial\gamma_m}{\partial x^\alpha}\end{aligned}\right]\right]\!\right]$$

$$g^{\alpha m}\frac{\partial\Gamma_{i\alpha,m}}{\partial x^j} = \left[\!\left[\left(\frac{1}{4}\right)g^{\alpha m}\left[\begin{aligned}&\frac{\partial\gamma_i}{\partial x^j}\frac{\partial\gamma_m}{\partial x^\alpha} + \gamma_i\frac{\partial^2\gamma_m}{\partial x^j\partial x^\alpha} - \frac{\partial\gamma_i}{\partial x^j}\frac{\partial\gamma_\alpha}{\partial x^m} - \gamma_i\frac{\partial^2\gamma_\alpha}{\partial x^j\partial x^m} + \frac{\partial^2\gamma_m}{\partial x^j\partial x^\alpha}\gamma_i + \frac{\partial\gamma_m}{\partial x^\alpha}\frac{\partial\gamma_i}{\partial x^j} - \frac{\partial^2\gamma_\alpha}{\partial x^j\partial x^m}\gamma_i\\ &- \frac{\partial\gamma_\alpha}{\partial x^m}\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_\alpha}{\partial x^j}\frac{\partial\gamma_m}{\partial x^i} + \gamma_\alpha\frac{\partial^2\gamma_m}{\partial x^j\partial x^i} - \frac{\partial\gamma_\alpha}{\partial x^j}\frac{\partial\gamma_i}{\partial x^m} - \gamma_\alpha\frac{\partial^2\gamma_i}{\partial x^j\partial x^m} + \frac{\partial^2\gamma_m}{\partial x^j\partial x^i}\gamma_\alpha\\ &+ \frac{\partial\gamma_m}{\partial x^i}\frac{\partial\gamma_\alpha}{\partial x^j} - \frac{\partial^2\gamma_i}{\partial x^j\partial x^m}\gamma_\alpha - \frac{\partial\gamma_i}{\partial x^m}\frac{\partial\gamma_\alpha}{\partial x^j} + \frac{\partial\gamma_m}{\partial x^j}\frac{\partial\gamma_i}{\partial x^\alpha} + \gamma_m\frac{\partial^2\gamma_i}{\partial x^j\partial x^\alpha} + \frac{\partial\gamma_m}{\partial x^j}\frac{\partial\gamma_\alpha}{\partial x^i} + \gamma_m\frac{\partial^2\gamma_\alpha}{\partial x^j\partial x^i} + \frac{\partial^2\gamma_i}{\partial x^j\partial x^\alpha}\gamma_m + \frac{\partial\gamma_i}{\partial x^\alpha}\frac{\partial\gamma_m}{\partial x^j} + \frac{\partial^2\gamma_\alpha}{\partial x^j\partial x^i}\gamma_m + \frac{\partial\gamma_\alpha}{\partial x^i}\frac{\partial\gamma_m}{\partial x^j}\end{aligned}\right]\right]\!\right]$$

$$\Gamma^\alpha_{\beta j}\Gamma^\beta_{i\alpha} = \left(\frac{1}{16}\right)\left[\!\left[\begin{aligned}&\left[g^{\alpha m}\left[\gamma_\beta\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)\gamma_\beta + \gamma_j\left(\frac{\partial\gamma_m}{\partial x^\beta} - \frac{\partial\gamma_\beta}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^\beta} - \frac{\partial\gamma_\beta}{\partial x^m}\right)\gamma_j + \gamma_m\left(\frac{\partial\gamma_\beta}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^\beta}\right) + \left(\frac{\partial\gamma_\beta}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^\beta}\right)\gamma_m\right]\right]\\ &\left[g^{\beta m}\left[\gamma_i\left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right)\gamma_i + \gamma_\alpha\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_\alpha + \gamma_m\left(\frac{\partial\gamma_i}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^i}\right)\gamma_m\right]\right]\end{aligned}\right]\!\right]$$

$$\Gamma^\alpha_{\beta\alpha}\Gamma^\beta_{ij} = \left(\frac{1}{16}\right)\left[\!\left[\begin{aligned}&\left[g^{\alpha m}\left[\gamma_\beta\left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^\alpha} - \frac{\partial\gamma_\alpha}{\partial x^m}\right)\gamma_\beta + \gamma_\alpha\left(\frac{\partial\gamma_m}{\partial x^\beta} - \frac{\partial\gamma_\beta}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^\beta} - \frac{\partial\gamma_\beta}{\partial x^m}\right)\gamma_\alpha + \gamma_m\left(\frac{\partial\gamma_\beta}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^\beta}\right) + \left(\frac{\partial\gamma_\beta}{\partial x^\alpha} + \frac{\partial\gamma_\alpha}{\partial x^\beta}\right)\gamma_m\right]\right]\\ &\left[g^{\beta m}\left[\gamma_i\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)\gamma_i + \gamma_j\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_j + \gamma_m\left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right)\gamma_m\right]\right]\end{aligned}\right]\!\right]$$

Inverse fundamental tensor

$$g^{\alpha m} = \left(\frac{\gamma^\alpha\gamma^m + \gamma^m\gamma^\alpha}{2}\right)$$

$g^{00} = 1$

$g^{11} = g^{22} = g^{33} = -1$

$$\nabla = \left(\frac{\partial}{\partial x^1} + \frac{\partial}{\partial x^2} + \frac{\partial}{\partial x^3}\right)$$

GEODESIC EQUATION IN A WEAK QUANTUM GRAVITATIONAL FIELD (Newtonian Gravity)

$$\frac{d^2x^\alpha}{(dx^0)^2} = -\left[\Gamma^\alpha_{00}\right]c^2 = -\frac{1}{2}\frac{\partial g_{00}}{\partial x^\alpha}c^2 = -\frac{1}{2}\left[\begin{aligned}&(\gamma_0 - (\gamma_1+\gamma_2+\gamma_3))\frac{\partial\gamma_0}{\partial x^0} + \frac{\partial\gamma_0}{\partial x^0}(\gamma_0 - (\gamma_1+\gamma_2+\gamma_3))\\ &+ \left(\gamma_0\left(\frac{\partial}{\partial x^0}(\gamma_1+\gamma_2+\gamma_3) - (\nabla)\gamma_0\right) + \left(\frac{\partial}{\partial x^0}(\gamma_1+\gamma_2+\gamma_3) - (\nabla)\gamma_0\right)\gamma_0\right)\end{aligned}\right]c^2 = -\left[\frac{2\pi}{ih}\overbrace{\left(\frac{E}{c} - \hat{P}_x - \hat{P}_y - \hat{P}_z\right)}^{m_0c}I\right]c^2$$

where 'h' is planck constant; 'I' is identity matrix

$$\gamma_0 - (\gamma_1+\gamma_2+\gamma_3) = \begin{pmatrix} 1 & 0 & 1 & 1-i \\ 0 & 1 & 1+i & 1 \\ -1 & -1+i & -1 & 0 \\ -1+i & 1 & 0 & -1 \end{pmatrix} \qquad \gamma_1+\gamma_2+\gamma_3 = \begin{pmatrix} 0 & 0 & -1 & -1+i \\ 0 & 0 & -1-i & -1 \\ 1 & 1-i & 0 & 0 \\ 1+i & -1 & 0 & 0 \end{pmatrix}$$

COMPLETENESS OF GEODESIC EQUATION WITH CHISTOFFEL SYMBOLS OF FIRST & SECOND KINDS

$$\frac{d^2x^\alpha}{ds^2} = -\left\{\Gamma^\alpha_{ij}\right\}\frac{dx^i}{ds}\frac{dx^j}{ds} = -\left\{g^{\alpha m}\frac{1}{4}\left(\underbrace{\gamma_i\left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^j} - \frac{\partial\gamma_j}{\partial x^m}\right)\gamma_i}_{\text{Curl of a Basis Vector "}\gamma_m\text{" [Skew-Symmetric Tensor or Rotational Tensor]}} + \underbrace{\gamma_j\left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right) + \left(\frac{\partial\gamma_m}{\partial x^i} - \frac{\partial\gamma_i}{\partial x^m}\right)\gamma_j}_{\text{Curl of a Basis Vector "}\gamma_m\text{" [Skew-Symmetric Tensor or Rotational Tensor]}} + \underbrace{\gamma_m\left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right) + \left(\frac{\partial\gamma_i}{\partial x^j} + \frac{\partial\gamma_j}{\partial x^i}\right)\gamma_m}_{\text{Symmetric Tensor}}\right)\right\}\frac{dx^i}{ds}\frac{dx^j}{ds}$$

QUANTUM FIELDS

NOTE: $\gamma_i, \gamma_j, \gamma_m$ are GAMMA MATRICES or also referred as BASIS VECTORS in Clifford Algebra.

COORDINATE TRANSFORMATION OF QUANTUM FIELDS

$$\frac{\partial^2 x^i}{\partial\bar{x}^\alpha\partial\bar{x}^m} = \frac{\partial x^i}{\partial\bar{x}^\eta}\left\{\frac{1}{4}\bar{g}^{\eta\mu}\left(\bar\gamma_\alpha\left(\frac{\partial\bar\gamma_\mu}{\partial\bar{x}^m} - \frac{\partial\bar\gamma_m}{\partial\bar{x}^\mu}\right) + \left(\frac{\partial\bar\gamma_\mu}{\partial\bar{x}^m} - \frac{\partial\bar\gamma_m}{\partial\bar{x}^\mu}\right)\bar\gamma_\alpha + \bar\gamma_m\left(\frac{\partial\bar\gamma_\mu}{\partial\bar{x}^\alpha} - \frac{\partial\bar\gamma_\alpha}{\partial\bar{x}^\mu}\right) + \left(\frac{\partial\bar\gamma_\mu}{\partial\bar{x}^\alpha} - \frac{\partial\bar\gamma_\alpha}{\partial\bar{x}^\mu}\right)\bar\gamma_m + \bar\gamma_\mu\left(\frac{\partial\bar\gamma_\alpha}{\partial\bar{x}^m} + \frac{\partial\bar\gamma_m}{\partial\bar{x}^\alpha}\right) + \left(\frac{\partial\bar\gamma_\alpha}{\partial\bar{x}^m} + \frac{\partial\bar\gamma_m}{\partial\bar{x}^\alpha}\right)\bar\gamma_\mu\right)\right\}$$

$$-\frac{1}{4}\frac{\partial x^s}{\partial\bar{x}^\alpha}\frac{\partial x^t}{\partial\bar{x}^m}g^{ip}\left(\gamma_s\left(\frac{\partial\gamma_p}{\partial x^t} - \frac{\partial\gamma_t}{\partial x^p}\right) + \left(\frac{\partial\gamma_p}{\partial x^t} - \frac{\partial\gamma_t}{\partial x^p}\right)\gamma_s + \gamma_t\left(\frac{\partial\gamma_p}{\partial x^s} - \frac{\partial\gamma_s}{\partial x^p}\right) + \left(\frac{\partial\gamma_p}{\partial x^s} - \frac{\partial\gamma_s}{\partial x^p}\right)\gamma_t + \gamma_p\left(\frac{\partial\gamma_s}{\partial x^t} + \frac{\partial\gamma_t}{\partial x^s}\right) + \left(\frac{\partial\gamma_s}{\partial x^t} + \frac{\partial\gamma_t}{\partial x^s}\right)\gamma_p\right)$$

NOTE: All components of "R_{ij}" were derived. *The Einstein convention summation rule was used in deriving all the equations presented in this poster.

$$R_{ij} = \begin{pmatrix} R_{00} & R_{01} & R_{02} & R_{03} \\ R_{10} & R_{11} & R_{12} & R_{13} \\ R_{20} & R_{21} & R_{22} & R_{23} \\ R_{30} & R_{31} & R_{32} & R_{33} \end{pmatrix}$$