Grand Unifying Fields Theory of Relativity and Quantum Mechanix: The Prediction of Graviton

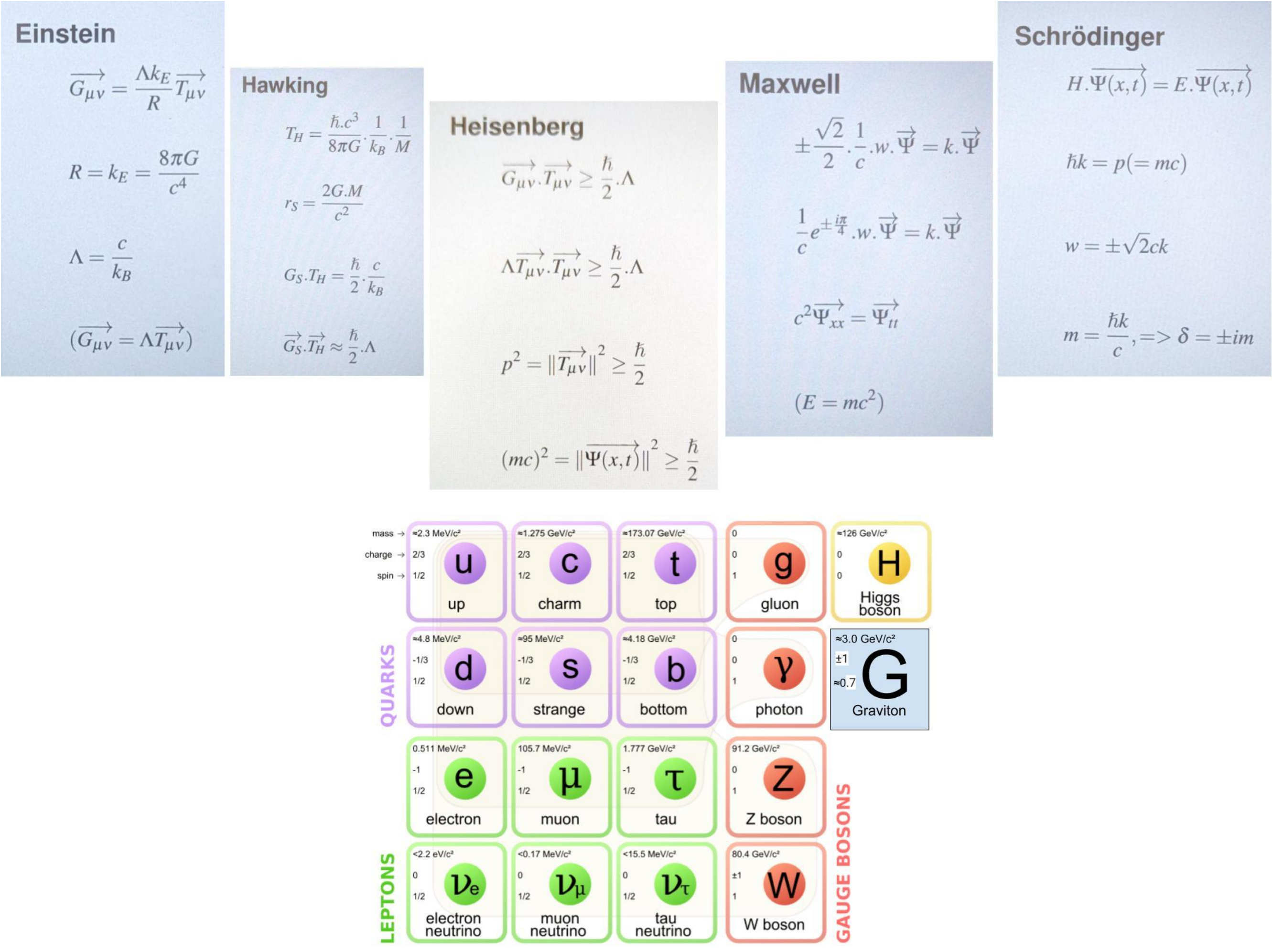
Aras Dargazany

Electrical Engineering Department, University of Rhode Island, Kingston, Rhode Island, USA, 02881.
Corresponding author: Aras Dargazany (aras.dargazany@gmail.com [***preferred***], arasdar@uri.edu).

ABSTRACT

This theory is an attempt to unify general relativity and quantum mechanics by integrating: Einstein Field Equation for Gravitational Wave in General Relativity; Schrödinger Field Equation for Quantum Wave in Quantum Mechanics; Maxwell Field Equation for Photon Wave in Electromagnetism; Hawking Field Equation for Radiation Wave in Black Holes; and Heisenberg Uncertainty Principle for Minimal Action (or Entropy). This unification leads to the potential prediction of Graviton (mass, charge, and spin).

Introduction to GUT: Grand Unifying fields Theory of relativity and quantum mechanix



Einstein

$$\overrightarrow{G_{\mu\nu}} = \frac{\Lambda k_E}{R}\overrightarrow{T_{\mu\nu}}$$

$$R = k_E = \frac{8\pi G}{c^4}$$

$$\Lambda = \frac{c}{k_B}$$

$$(\overrightarrow{G_{\mu\nu}} = \Lambda\overrightarrow{T_{\mu\nu}})$$

Hawking

$$T_H = \frac{\hbar.c^3}{8\pi G}.\frac{1}{k_B}.\frac{1}{M}$$

$$r_S = \frac{2G.M}{c^2}$$

$$G_S.T_H = \frac{\hbar}{2}.\frac{c}{k_B}$$

$$\overrightarrow{G_S}.\overrightarrow{T_H} \approx \frac{\hbar}{2}.\Lambda$$

Heisenberg

$$\overrightarrow{G_{\mu\nu}}.\overrightarrow{T_{\mu\nu}} \geq \frac{\hbar}{2}.\Lambda$$

$$\Lambda\overrightarrow{T_{\mu\nu}}.\overrightarrow{T_{\mu\nu}} \geq \frac{\hbar}{2}.\Lambda$$

$$p^2 = \|\overrightarrow{T_{\mu\nu}}\|^2 \geq \frac{\hbar}{2}$$

$$(mc)^2 = \|\overrightarrow{\Psi(x,t)}\|^2 \geq \frac{\hbar}{2}$$

Maxwell

$$\pm\frac{\sqrt{2}}{2}.\frac{1}{c}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi}$$

$$\frac{1}{c}e^{\pm\frac{i\pi}{4}}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi}$$

$$c^2\overrightarrow{\Psi_{xx}} = \overrightarrow{\Psi_{tt}}$$

$$(E = mc^2)$$

Schrödinger

$$H.\overrightarrow{\Psi(x,t)} = E.\overrightarrow{\Psi(x,t)}$$

$$\hbar k = p(=mc)$$

$$w = \pm\sqrt{2}ck$$

$$m = \frac{\hbar k}{c}, => \delta = \pm im$$

Figure 1. GUT in a nutshell.

Materials and Methods I

Einstein Field Equation for Gravitational Wave in General Relativity[1]

$$G_{\mu\nu} + \lambda g_{\mu\nu} = k_E T_{\mu\nu} \tag{1}$$

In equation 1, $G_{\mu\nu}$: Gravitational(-Potential) Tensor; $\lambda = (\Lambda - \frac{1}{2}R)$; $g_{\mu\nu}$: Metric Tensor; k_E: Einstein[13] Constant;

$$R_{\mu\nu} + (\Lambda - \frac{1}{2}R) g_{\mu\nu} = k_E T_{\mu\nu} \tag{2}$$

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = k_E T_{\mu\nu} \tag{3}$$

In equation 3, $R_{\mu\nu}$: Ricci[20] Tensor; R: Ricci[21] Scalar; Λ: Cosmological[14] Constant; $T_{\mu\nu}$: Energy(-Momentum) Tensor;

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = -\Lambda g_{\mu\nu} + k_E T_{\mu\nu} \tag{4}$$

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = k_E T_{\mu\nu} - \Lambda g_{\mu\nu} \tag{5}$$

$$\frac{R_{\mu\nu}}{R} - \frac{g_{\mu\nu}}{2} = \frac{k_E}{R} T_{\mu\nu} - \frac{\Lambda}{R} g_{\mu\nu} \tag{6}$$

$$\frac{R_{\mu\nu}}{R} - \frac{g_{\mu\nu}}{2} = \frac{\Lambda k_E}{R} (\frac{T_{\mu\nu}}{\Lambda} - \frac{g_{\mu\nu}}{k_E}) \tag{7}$$

$$G_{\mu\nu} - \frac{g_{\mu\nu}}{2} = \frac{\Lambda k_E}{R} (T_{\mu\nu} - \frac{g_{\mu\nu}}{k_E}) \tag{8}$$

$$G_{\mu\nu} + B = \frac{\Lambda k_E}{R} (T_{\mu\nu} + \beta) \tag{9}$$

$$\overrightarrow{G_{\mu\nu}} = \frac{\Lambda k_E}{R} \overrightarrow{T_{\mu\nu}} \tag{10}$$

In equation 10, $\overrightarrow{G_{\mu\nu}}$: Gravitational(-Potential) Vector (Gravitational Wave)[15]; $\overrightarrow{T_{\mu\nu}}$: Energy(-Momentum) Vector (Raditation Wave)[4];

$$R = k_E = \frac{8\pi G}{c^4} \tag{11}$$

In equation 11, G: Newton[18] Gravitational Constant; c: speed of light[3];

$$G \simeq 6.67430 \times 10^{-11} (\frac{m^3}{kg.s^2}) \approx 6.67 \times 10^{-11} (\frac{m^3}{kg.s^2}) \tag{12}$$

$$c \approx 3 \times 10^8 (\frac{m}{s}) \approx 186000 (\frac{miles}{sec}) \tag{13}$$

$$\Lambda = \frac{c}{k_B} \tag{14}$$

In equation 14, k_B: Boltzmann [19] Constant;

$$k_B \approx 1.38 \times 10^{-23} [\frac{J}{K} (\frac{Joul}{Kelvin})] or (\frac{kg.m^2}{s^2.K}) \tag{15}$$

Materials and Methods II

Schrödinger Field Equation for Quantum Wave in Quantum Mechanics[2]

$$H.\overrightarrow{\Psi(x,t)} = E.\overrightarrow{\Psi(x,t)} \tag{16}$$

In equation 16, H: Hamiltonian[22] $(H = T + U)$; E: Planck[11] Energy $(E = \hbar w)$; $\overrightarrow{\Psi(x,t)}$: Schrödinger[16] wave function of space-time[17];

$$\overrightarrow{\Psi(x,t)} = e^{jwt}.e^{-jkx} \tag{17}$$

In equation 17, f: frequency $(w = 2\pi f)$; λ: deBroglie[10] wavelength $(k = \frac{1}{\lambda})$;

$$(\hbar w).\overrightarrow{\Psi(x,t)} = -\frac{\hbar^2}{2m}.\frac{\partial^2}{\partial x^2}\overrightarrow{\Psi(x,t)} + U.\overrightarrow{\Psi(x,t)} \tag{18}$$

In equation 18, $\hbar$: reduced Planck[11] Constant;

$$\hbar \simeq 1.05 \times 10^{-34}(\frac{kg.m^2}{s}) \approx 10^{-34}(\frac{kg.m^2}{s}) \tag{19}$$

$$(\hbar w).\overrightarrow{\Psi(x,t)} = \frac{p^2}{2m}.\overrightarrow{\Psi(x,t)} + U.\overrightarrow{\Psi(x,t)} \tag{20}$$

In equation 20, p: Momentum; T: Universal Kinematic (Momentum) Energy $(T = \frac{p^2}{2m})$;

$$\hbar w = \frac{p^2}{2m} + U \tag{21}$$

In equation 21, m: mass; U: Universal Rest (Potential) Energy $(U = mc^2)$ (44)[23];

$$\hbar w = \frac{p^2}{2m} + mc^2 \tag{22}$$

$$\hbar k = p(= mc) \tag{23}$$

$$\hbar ck = pc(= mc^2) \tag{24}$$

$$\hbar w = pc(= mc^2) \tag{25}$$

$$w \neq ck \tag{26}$$

$$(\hbar w)^2 = (pc)^2 + (mc^2)^2 \tag{27}$$

$$(\hbar w)^2 = 2(\hbar ck)^2 \tag{28}$$

$$\hbar w = \pm\sqrt{2}(\hbar ck) \tag{29}$$

$$w = \pm\sqrt{2}ck \tag{30}$$

Materials and Methods III

Maxwell Field Equation for Photon Wave in Electromagnetism[3]

$$w.\overrightarrow{\Psi(x,t)} = \pm\sqrt{2}ck.\overrightarrow{\Psi(x,t)} \tag{31}$$

$$\pm\frac{1}{\sqrt{2}c}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi} \tag{32}$$

$$\pm\frac{\sqrt{2}}{2}.\frac{1}{c}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi} \tag{33}$$

$$\pm\frac{1}{c}e^{\frac{i\pi}{4}}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi} \tag{34}$$

$$\frac{1}{c}e^{\pm\frac{i\pi}{4}}.w.\overrightarrow{\Psi} = k.\overrightarrow{\Psi} \tag{35}$$

$$\frac{1}{c}e^{\pm\frac{i\pi}{4}}.w = k \tag{36}$$

$$\frac{1}{c}e^{-\frac{i\pi}{4}}.w.(\frac{1}{c}e^{+\frac{i\pi}{4}}.w.(\overrightarrow{\Psi})) = k.(k.(\overrightarrow{\Psi})) \tag{37}$$

$$\frac{1}{c}e^{-\frac{i\pi}{4}}\cdot\frac{\partial}{\partial t}\cdot(\frac{1}{c}e^{+\frac{i\pi}{4}}\cdot\frac{\partial}{\partial t}\cdot(\overrightarrow{\Psi})) = \frac{\partial}{\partial x}\cdot(\frac{\partial}{\partial x}\cdot(\overrightarrow{\Psi})) \tag{38}$$

$$\frac{1}{c}\cdot\frac{\partial}{\partial t}\cdot(\frac{1}{c}\cdot\frac{\partial}{\partial t}\cdot(\overrightarrow{\Psi})) = \frac{\partial}{\partial x}\cdot(\frac{\partial}{\partial x}\cdot(\overrightarrow{\Psi})) \tag{39}$$

$$\frac{1}{c^2}\cdot\frac{\partial}{\partial t}\cdot(\frac{\partial}{\partial t}\cdot(\overrightarrow{\Psi})) = \frac{\partial}{\partial x}\cdot(\frac{\partial}{\partial x}\cdot(\overrightarrow{\Psi})) \tag{40}$$

$$\frac{1}{c^2}\cdot(\frac{\partial^2}{\partial t^2}\cdot\overrightarrow{\Psi}) = \frac{\partial^2}{\partial x^2}\cdot\overrightarrow{\Psi} \tag{41}$$

$$\frac{1}{c^2}\overrightarrow{\Psi_{tt}} = \overrightarrow{\Psi_{xx}} \tag{42}$$

$$c^2\overrightarrow{\Psi_{xx}} = \overrightarrow{\Psi_{tt}} \tag{43}$$

$$(E = mc^2) \tag{44}$$

Materials and Methods IV

Hawking Field Equation for Radiation Wave in Black Holes[4]

$$T_H = \frac{\hbar.c^3}{8\pi G}.\frac{1}{k_B}.\frac{1}{M} \tag{45}$$

In equation 45, T_H: The potential (Hawking[4]) radiation in black holes;

$$r_S = \frac{2G.M}{c^2} \tag{46}$$

In equation 46, r_S: The potential (Schwarzschild[7]) radius of black holes;

$$M = \frac{r_S.c^2}{2G} \tag{47}$$

In equation 47, M: The potential mass of black holes[8];

$$T_H = \frac{\hbar.c^3}{8\pi G}.\frac{1}{k_B}.\frac{2G}{r_S.c^2} \tag{48}$$

$$T_H = \frac{\hbar.c^3}{4\pi}.\frac{1}{k_B}.\frac{1}{r_S.c^2} \tag{49}$$

$$T_H = \frac{\hbar.c}{4\pi}.\frac{1}{k_B}.\frac{1}{r_S} \tag{50}$$

$$T_H = \frac{\hbar}{2}.\frac{c}{k_B}.\frac{1}{2\pi r_S} \tag{51}$$

$$T_H.(2\pi r_S) = \frac{\hbar}{2}.\frac{c}{k_B} \tag{52}$$

$$T_H.\frac{\partial(\pi r_S{}^2)}{\partial r_S} = \frac{\hbar}{2}.\frac{c}{k_B} \tag{53}$$

$$T_H.G_S = \frac{\hbar}{2}.\frac{c}{k_B} \tag{54}$$

In equation 54, G_S: The potential gravitation in black holes[12];

$$G_S.T_H = \frac{\hbar}{2}.\frac{c}{k_B} \tag{55}$$

$$\overrightarrow{G_S}.\overrightarrow{T_H} \approx \frac{\hbar}{2}.\Lambda \tag{56}$$

Materials and Methods V

Heisenberg Uncertainty Principle for Minimal Action (or Entropy)[5]

$$\overrightarrow{G_{\mu\nu}}.\overrightarrow{T_{\mu\nu}} \geq \frac{\hbar}{2}.\Lambda \tag{57}$$

$$\Lambda\overrightarrow{T_{\mu\nu}}.\overrightarrow{T_{\mu\nu}} \geq \frac{\hbar}{2}.\Lambda \tag{58}$$

$$p^2 = \|\overrightarrow{T_{\mu\nu}}\|^2 \geq \frac{\hbar}{2} \tag{59}$$

$$\hbar k = p = mc = \|\overrightarrow{\Psi(x,t)}\| \tag{60}$$

$$m = \frac{\hbar k}{c}, => \delta = \pm im, => (\delta^2 + m^2).\overrightarrow{\Psi(x,0)} = 0, => (\delta + im).(\delta - im).\overrightarrow{\Psi(x,0)} = 0 \tag{61}$$

In equation 61, δ: Delta Dirac[9] mass of two imaginary particles with opposite charges (matter and antimatter);

$$(mc)^2 = \|\overrightarrow{\Psi(x,t)}\|^2 \geq \frac{\hbar}{2} \tag{62}$$

$$p(= mc) \geq 0.7 \times 10^{-17} \tag{63}$$

$$m \geq 0.7 \times 10^{-17} \times \frac{1}{c} \times c^2 (\frac{eV}{c^2}) \tag{64}$$

$$m \geq 0.7 \times 10^{-17} \times c(\frac{eV}{c^2}) \tag{65}$$

$$m \geq 0.7 \times 10^{-17} \times 3 \times 10^8 (\frac{eV}{c^2}) \tag{66}$$

$$m \geq 0.7 \times 3 \times 10^{-9} (\frac{eV}{c^2}) \tag{67}$$

$$m = \pm 3 \times 0.7 \times 10^{-9} (\frac{eV}{c^2}) \tag{68}$$

$$m = \pm 3 \times 0.7 (\frac{GeV}{c^2}) \tag{69}$$

$$m \geq 2.1 (\frac{GeV}{c^2}) \tag{70}$$

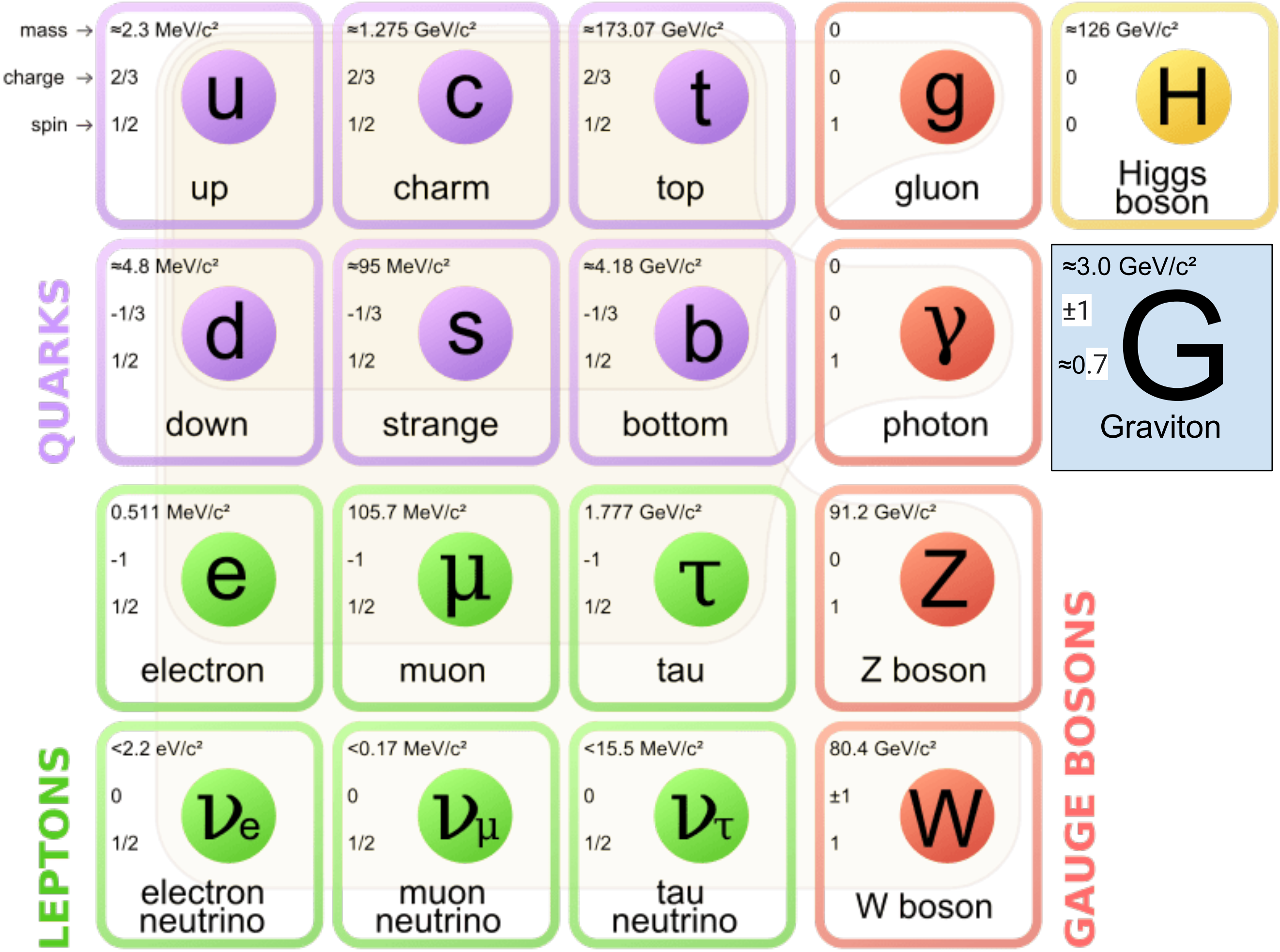


Figure 2. The potential prediction of Graviton (mass, charge, and spin).

Results and Discussion

This unification leads to the potential prediction of Graviton (mass, charge, and spin)[6] accordingly (Figure 1 and Figure 2): Graviton's spin might be $\geq \frac{\sqrt{2}}{2} (\simeq 0.7)$; Graviton might be the most similar, in terms of charge, to W-Boson; Graviton's mass is close to *Zero* $(\approx 3.0[\frac{GeV}{c^2}])$ compared to W-Boson mass $(\approx 80.4[\frac{GeV}{c^2}])$ and Z-Boson mass $(\approx 91.2[\frac{GeV}{c^2}])$.

Data Availability

No underlying data was collected nor produced in this study.

Conflicts of Interest

Not available.

Funding Statement

This study was self-funded.

References

1. Einstein: "The general theory of relativity", Springer, 1922.
2. Schrödinger: "An undulatory theory of the mechanics of atoms and molecules", Physical Review, 1926.
3. Maxwell: "A dynamical theory of the electromagnetic field", Philosophical Transactions of the Royal Society, 1865.
4. Hawking: "Black hole explosions?", Nature, 1974.
5. Heisenberg: "Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik", Zeitschrift für Physik, 1927.
6. Aras Dargazany: "Grand unifying fields theory of relativity and quantum mechanix", (researchgate.net/publication/369527311_Grand_Unifying_Fields_Theory_of_Relativity_and_Quantum_Mechanix), 2023.
7. Schwarzschild: "Über das Gravitationsfeld eines Massenpunktes nach der Einsteinschen Theorie", Sitzungsberichte der Königlichen Akademie der Wissenschaften, 1916.
8. Schwarzschild: "Über das Gravitationsfeld einer Kugel aus inkompressibler Flüssigkeit nach der Einsteinschen Theorie", Sitzungsberichte der Königlichen Akademie der Wissenschaften, 1916.
9. Dirac: "The Principles of Quantum Mechanics", Oxford University Press, 1930.
10. deBroglie: "Recherches sur la théorie des Quanta", Dissertation: Physique Migration-université en cours d'affectation, 1924.
11. Planck: "Über das Gesetz der Energieverteilung im Normalspectrum", Annalen der Physik, 1901.
12. Hawking: "The theory of everything: The Origin and Fate of the Universe", Jaico Publishing House, 2006.
13. Einstein: "Die Feldgleichungen der Gravitation", Sitzungsberichte der Königlichen Akademie der Wissenschaften, 1915.
14. Einstein: "Näherungsweise Integration der Feldgleichungen der Gravitation", Sitzungsberichte der Königlichen Akademie der Wissenschaften, 1916.
15. Einstein: "Über Gravitationswellen", Sitzungsberichte der Königlichen Akademie der Wissenschaften, 1918.
16. Schrödinger: "Quantisierung als Eigenwertproblem", Annalen der Physik, 1926.
17. Schrödinger: "Space-Time Structure", Cambridge University Press, 1950.
18. Newton: "Philosophiæ Naturalis Principia Mathematica", Philosophical Transactions of the Royal Society, 1687.
19. Boltzmann: "Die Abhängigkeit der Wärmestrahlung von der Temperatur aus der elektromagnetischen Lichttheorie", Annalen der Physik, 1884.
20. Raychaudhuri: "Relativistic cosmology", Physical Review, 1955.
21. Riemann: "Über die Hypothesen, welche der Geometrie zu Grunde liegen", Lecture: Dietrich, 1867.
22. Hamilton: "On a General Method of Expressing the Paths of Light, and of the Planets, by the Coefficients of a Characteristic Function", PD Hardy, 1833.
23. Einstein: "On the electrodynamics of moving bodies", Annalen der Physik, 1905.

State of The Art in Theoretical Physics: Cover Letter

Dear Readers and Reviewers of this paper,

This paper proposes a potential theory to finish Einstein's unfinished manuscript so-called: "Grand Unified Field Theory (of Relativity)".

M-theory (string theory) and Loop Quantum Gravity (LQG) were two significant subsequent attempts after Einstein's, intending to unify general relativity and quantum mechanics in the pursuit of quantum gravity but without any testable prediction so far ...

My theory is also an attempt in this direction but with the testable prediction of Graviton (mass, charge, and spin) and its potential addition to the standard model of subatomic particles in Physics.

That is why the proposal and publication (of my theory and my paper) would be a stepping stone towards my main two objectives:
1- the experimental testing of my theory in Fermi-Lab (USA) and Cern-LHC (EU);
2- the potential nomination of my theory for the Nobel Prize in Physics category;

Therefore, I'd like to ask for your kind consideration of my paper and my theory.

Sincerely yours,
Aras Dargazany,
University of Rhode Island,
Kingston, Rhode Island, USA.

Grand unifying fields theory of relativity and quantum mechanix: https://www.researchgate.net/publication/369527311_Grand_Unifying_Fields_Theory_of_Relativity_and_Quantum_Mechanix