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Theoretical Solutions for Dark Matter and Dark Energy

Imran M. Khan, *B.S., M.S. Nuclear Physics, M.B.A., Independent Researcher, Open Research Community;* ikhan204@gmail.com,
ORC id: https://ORCID.org/0000-0003-2369-6947

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ABSTRACT:

In this research paper, we provide scientific evidence to confirm that within the celestial spheres, dark matter is embedded inside each Solid Spherical Iron Core (SSIC) that also proportionally generates dark energy. Dark matter is an embedded repulsive force that manifests as degeneracy pressure to counterbalance and avoid gravitational core collapse while adding dark mass-energy to the SSICs. Conversely, dark energy is an attractive force that becomes residual surface gravity at the celestial sphere external surfaces from where it contributes to the cosmic-web and its vacuum density. From the principles of nuclear physics, we derive and provide proofs demonstrating that the critical density ratios of ΛCDM (Lamda Cold Dark Matter) universe composition are the same from the quantum-scale structure (including quark combinations and nucleons inside SSIC iron atoms) to the known universe large-scale structure. Our holistic '*100% Total Mass-Energy*' Quantum Mass-Energy (QME) theory is based on a three-dimensional Euclidean space coordinate system that fully matches previous works' results of the complex four-dimensional tensor-based Einstein field equations, Friedman solutions, and the ΛCDM universe model. Our QME results accurately match the satellite measurement studies' results with small mean percent errors for NASA WMAP (3.24%), multi-year WMAP collaboration (2.66%), and ESA Planck (0.26%). The research's main finding is that dark matter and dark energy ΛCDM composition of the universe large-scale structure is identical within each gravity generating celestial sphere and celestial formation across the entire universe. Finally, these predictive and scientifically sound QME principles, laws, and equations presented here allow any competent science reader to compute in a matter of minutes the ΛCDM composition of any gravity generating celestial sphere in the universe.

1.0 BACKGROUND:

For the past 100 years, full understanding of the nature, mechanism, and the location of dark matter [1] and dark energy [2] has eluded us. When Newton first introduced gravitation in 1687, it was purely based on visible mass and at the time there was no concept of dark-matter or dark-energy [3]. Einstein with his ten complex field equations defined gravitation in 1916 as a resultant of a four-dimensional space-time curvature produced by mass-energy [4]. In 1922, Friedman applied the cosmological principle (i.e. spatially homogeneous and isotropic universe) to solve Einstein's Field equations. From Friedman's solutions, the relationship between the actual density and the critical density define the overall geometry of the universe [5]. In 1933, Fritz Zwicky while examining the Coma galaxy cluster used the viral theorem to infer the existence of 'Dark Matter'[6]. Dark matter was estimated to be about 25% of the total mass energy of the universe. In 1936, separate from cosmology, seismologist Inge Lehmann deduced existence of Earth's solid inner iron core [7]. In the field of nuclear physics, Hideki Yukawa introduced nucleon potential in 1937 [8]. Based on Yukawa potential, in 1968, R. V. Reid quantified Reid potential showing nucleon-to-nucleon co-resident attractive and repulsive forces that decay as a function of distance [9]. In later years, the non-zero vacuum energy in empty space was determined to be dark energy estimated to be about 70% of the total mass energy of the universe. In 1998, Michael Turner described non-zero vacuum energy by coining the term 'Dark Energy'[10]. From all these cosmological solutions and observations (excluding the nuclear physics-related developments), the ΛCDM nominal universe composition has been determined to be about 25% dark matter, about 70% dark energy, and the remaining 5% visible matter. However, over the past century the true nature, mechanism and the location of dark matter and dark energy has remained a scientific mystery.

Based on this historical background, what we know for certain is that the Newtonian gravitation physics is compatible only with about 5% visible mass and does not account for any dark matter or dark energy. Einstein's four-dimensional space-time curvature based field equations, Friedman solutions, and ΛCDM solutions fully account for '100% Total Mass-Energy' but all of these theories fail to quantify the true nature, mechanism, and the location of dark matter and dark energy. QME original research theory presented in this paper by also factoring in principles from nuclear physics, not only independently matches the results of these past theories, but also clearly describes the true nature, mechanism, and the specific location of dark matter and dark energy distribution in the universe [11].

2.0 OBJECTIVE:

As summarized above, the challenge of discovering the true nature, mechanism, and the location of dark matter and dark energy has been facing the scientific community for the past hundred years without much success. Fruitless research experiments have been conducted deep inside abandoned mines in Gran Sasso Lab in Italy, US (South Dakota, Minnesota), and in Japan (e.g. Xenon100, LUX, PICO 60, Darkside-50, SuperCDMS, ArDMX-2, etc.). Millions in tax-payer funds are being spent to build and deploy satellites to detect dark matter and dark energy (e.g. AMS, Fermi Gamma-Ray Space Telescope, etc.). Without fully understanding its true nature, hundreds of astronomers and researchers worldwide are collaborating on multi-year mega projects to map dark-matter and dark-energy (e.g. Dark energy survey using DECam, Sloan digital sky survey using CCDs, etc.). Similarly, many new complex alternative theories are trying to resolve these paradoxes including string theory with 10^{500} vacuum states (possible number of universes), multiverse with six different universe bubbles, and M-theory extension with eleven spacetime dimensions. Then there are Quantum Field Theory (QFT) predictions that are off by 120 orders of magnitude (10^{120}) compared to the correctly measured energy density of vacuum. This error magnitude between QFT theory prediction and the correct measured value is larger than the size of the universe and has been labeled as "the worst theoretical prediction in the history of physics"! [12]

The celestial phenomenon that repeats itself trillions of times throughout the universe should not require complex four-dimensional field equations, 10^{500} universes, six multiverses, eleven dimensional M-theory, or QFT predictions with error magnitudes greater than the size of the universe, unless our current physics base fundamentals are completely flawed at their core.

Against this backdrop, we present the Quantum Mass-Energy (QME) original-research theory that provides holistic, predictable, non-relativistic, and testable mass-energy solutions. The QME mass-energy gravitational solutions work in the traditional real-life three-dimensional Euclidean space coordinate system that fully accounts for the 100% Total mass-energy of all gravity generating celestial spheres and formations in the universe. As such, QME fully accounts for dark matter and dark energy. QME theory independently matches the results of the highly complex four-dimensional spacetime curvature based Einstein field equations, Friedman solutions, and the ΛCDM composition of the universe. It also precisely matches NASA WMAP [13] and the latest European Space Agency (ESA) Planck satellite measured universe mass-energy composition results (2015) with a mean percent accuracy of 99.74% [14].

Consequently, our research objective is to provide a holistic '100% Total Mass-Energy' based fundamental universal gravitational model that also fully accounts for dark matter and dark energy while accurately describing its true scientific nature, mechanism and locations in the universe.

3.0 INTRODUCTION:

In this research paper, we theoretically provide solutions to these outstanding problems in physics with an independent, predictive, measurable, and testable QME theory, based on 100% Total Mass-Energy. The QME theory along with its Reverse Path Gravity-scaling (RPG) laws [15], describes the true nature, mechanism, and the location of dark matter and dark energy within each celestial sphere and formation in the universe.

4.0 METHODOLOGY:

We apply the scientific research methodology as follows:

- From nuclear physics, we develop and present three key unique axioms describing the source and the nature of nucleon forces
- Derive and express QME related axioms and assertions describing the mechanism of dark matter and dark energy
- Apply Reverse Path Gravity-scaling (RPG) laws of mass energy that quantify and identify the location of dark matter and dark energy
- Validate QME theory with solar system, galaxy, neutron star, and the universe model. Finally we compare QME/RPG results with previous works, ΛCDM, and the ESA Planck satellite measured data

5.0 ANALYSES:

The following three external scientific principles applied to cosmology and astrophysics are borrowed from nuclear physics. Without our nuclear physics research developed principles the present day enigma's and paradoxes in cosmology and astrophysics will remain unsolved for eternity. These three puzzle pieces are: (i) Binding energy per nucleon curve [16], (ii) Yukawa interaction and Reid nucleon potential [8][9], and (iii) the QME strong force channeling and scaling by Iron atom nucleons and their quark combinations [11].

Our research confirms that nucleons as a function of celestial pressures, possess both attractive and repulsive forces that are co-existent and proportional in nature. In an Iron atom nucleus the down-quark combinations are responsible for channeling and scaling strong force as a function of extreme celestial pressures.

5.1 Universal Celestial Seed Element and Seed Particles:

By observing the Nuclear binding energy curve from nuclear physics in Figure-1, the stable Iron (^{56}Fe) isotope has the highest binding energy of 8.7906 Mev per nucleon [17]. Iron also has the least propensity for fission or fusion, has magnetic, electromagnetic, and gravitation properties, is found in relative abundance throughout the universe (including galaxies, interstellar and intergalactic space), and also has across the board superior material mechanical strength properties. Just like the celestial spheres in nature, humans also utilize iron (steel) structures as the primary foundational material around which cement (silicon) is poured to attain maximum material strength. Iron is also one of the heaviest nucleosynthesis elements, allowing it to migrate and accumulate at the centers of celestial spheres.

Therefore, based on all of the above attributes the element Iron (^{56}Fe) is the most qualified candidate to qualify as the celestial seed element that forms all gravity generating SSIC and Gravity Generating Core (GGC) formations.

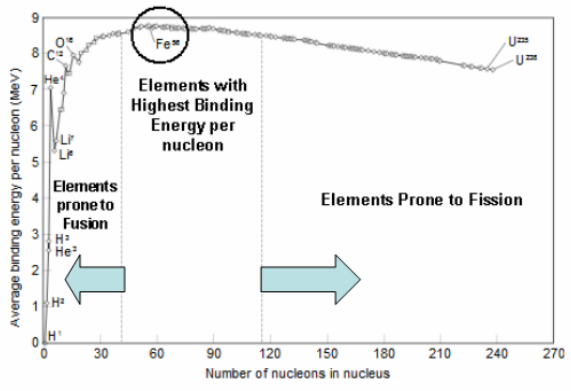


Figure-1: *Nuclear binding energy curve showing stable Iron isotope with the highest binding energy per nucleon that is also not prone to either fission or fusion*

5.2 Co-resident Proportional Attractive and Repulsive Forces

Based on Yukawa interaction [8], in 1968, R. V. Reid quantified Reid potential as nucleon-to-nucleon potential showing nucleons possess both co-resident attractive and repulsive forces.[9] As shown in Figure-2, the nucleon attractive force of about (25,000N) has a maximum at 1 fm. The large repulsive force at 0.8 fm has a maximum repulsive force of about +6600N. In our research, by carefully analyzing the Reid potential curve we discovered the ΛCDM ratios to be valid at these quantum nucleon levels. By taking the ratio of the nucleon-to-nucleon attractive and repulsive force potential, we discovered that they match the dark matter and dark energy ΛCDM ratios. For example, from the Yukawa/Reid Potential nucleon chart, we solve:

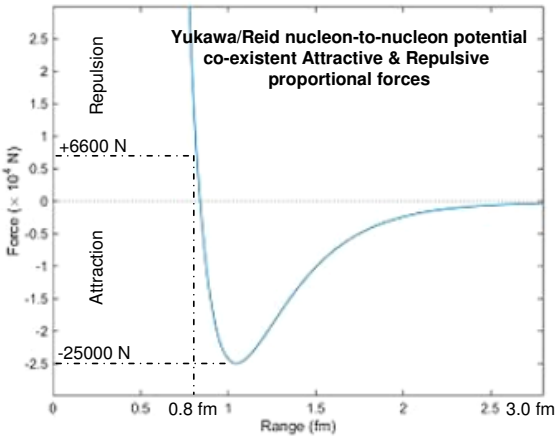


Figure-2: *Yukawa/Reid Potential nucleon-to-nucleon co-existent and proportional Attraction and Repulsion forces given in Newtons(N) versus Range in femtometers(fm).*

(i) **Dark Matter:** Nucleon Repulsive force (N): (6575[1] ÷ 25000) = 0.2630

Subtracting dark matter and baryon visible matter (4.85%) from the normalized total provides the remaining dark energy:

(ii) **Dark Energy:** Nucleon Attractive force: [1- (0.2630 + 0.0485)] = 0.6885

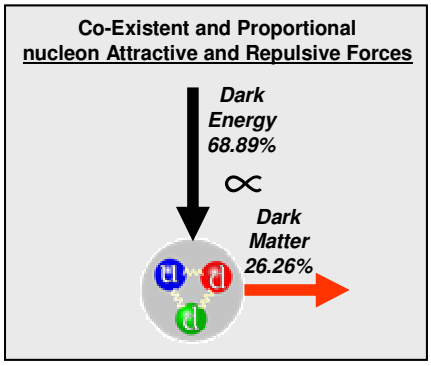


Figure-3: *Nucleon with resident up and down quarks showing both the co-existent and proportional Attractive and Repulsive force fields equivalent to QME calculated values.*

Based on above results, our research confirms that the nucleon-to-nucleon dark matter and dark energy ratios match the ΛCDM data. These nucleon-to-nucleon ratios are a constant, and they scale-up and scale-out proportionally as a function of extreme celestial degeneracy pressures.

[1] *Chart values interpolated fractionally to exactly converge with ΛCDM data*

5.3 Quark Mass-Energy Channeling and scaling (QMC):

A) Dark Energy channeling from Neutron Down-quarks:

The neutron resident down-quarks inside the Iron atom nucleus channel 68.89% attractive mass-energy as the long range attractive strong force that scales up and scales out. Each ^{56}Fe atom nucleus has a total of 86 down-quarks that are responsible for channeling mass-energy forces. The sixty ^{56}Fe neutron down-quarks (30 ^{56}Fe neutrons times 2 down-quarks per neutron = 60) channel (60÷86)*100.0 = 69.77% dark energy. From the nucleon binding energy curve, we have average binding energy of each iron nucleon equal to 8.79 MeV[17]. The total energy of a neutron is 939.57 MeV [18]. An adjustment is required for the binding energy (8.79 ÷ 939.57)*100.0 = 0.9355% per nucleon that stays behind within the nucleus. By subtracting the percent resident binding energy from the percent dark energy flux that is radiated out, we get net (69.77% - 0.9355%) = 68.83% that closely matches the large-scale universe ΛCDM ratio for dark energy. This dark energy flux is emitted out from the SSIC surface to the cosmic-web as a function of inverse squared law.

B) Dark Matter channeling from Proton Down-quarks:

The proton resident down-quarks embed 26.3% repulsive mass-energy inside the SSIC iron core. The twenty-six ^{56}Fe proton down-quarks (26 protons with 1 down-quark each = 26) channel out (26÷86)*100.0 = 30.23% Matter Mass-Energy (MME). The total energy of a proton is 938.27 MeV [18]. By adding back the proton binding energy (8.79 ÷ 938.27)*100 = 0.9368% that stays within the nucleus, we get 31.17% closely matching the large-scale universe ΛCDM ratio for total baryon matter (dark + visible). With a one-to-one electron-proton parity ratio inside the ^{56}Fe atoms, about (31.17% – 4.85%) = 26.32% of dark matter is embedded inside each SSIC to maintain its structural integrity and to counterbalance the celestial gravitation. The remaining 4.85% mass-energy manifests as Baryon Visible Matter (BVM). The nature of Dark-Matter is a repulsive force embedded inside the SSIC that counterbalances celestial gravitation and upholds electron degeneracy pressures up to the Chandrasekhar limit of 1.44 solar masses [19].

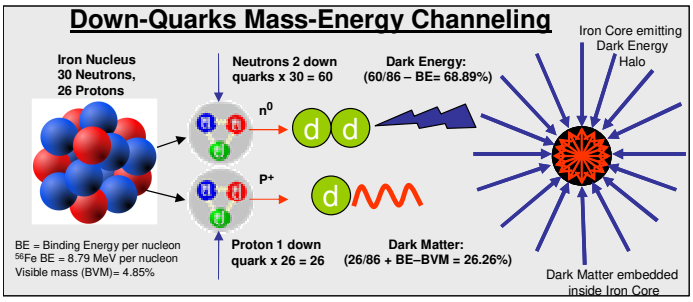


Figure-4: *For SSICs, mass-energy channeling starts from nucleon resident down-quarks within Iron nucleus that collectively manifests into dark matter and dark energy.*

5.4 Reverse Path Gravity-scaling (RPG) Method:

The RPG methodology [15] applies the Inverse squared law in the reverse direction moving from the celestial sphere known surface gravity to the SSIC surface. This is scientifically justifiable because dark matter, dark energy, and gravitation do not suffer permeability or permitivitty losses, are invisible on the electromagnetic spectrum, and do not interact with visible matter except gravitationally. RPG methodology is based on 100% Total Mass-Energy, compared to the Newtonian gravitation reference base of only ~5% 'Visible Matter'.

5.4.1 Mass-Energy Universal principles and constants:

Throughout the universe from the quantum-scale structure to the large-scale structure, the theoretically calculated Mass-Energy (Ж) principles are:

Celestial Spheres M-E Ж(g, ρ, m) Ratios ≡ Universal Constants ≡ ΛCDM

- Mass-Energy (M-E) Equivalence principle: $E = mc^2$ [4]
- Cosmological principle: isotropic & homogeneous universe [5]
- QME principle: Total M-E(Ж) ≡ m(p) ↔ [(Ж$_{DM}$ + Ж$_{DE}$) + BVM] ↔ E/c^2
- 'Total Mass-Energy' concentrated at celestial sphere/formation center
- Dark M-E permeability (ε_0), permittivity (μ_0) losses through any medium =0
- Effective M-E Halo size: 4.88*R_C ∝ 17% R_S relative radius elastic sphere
- Nucleons posses proporational, co-existent, attractive, and replusive quantum forces with ratios that match large-scale universe ΛCDM composition ratios
- For all celestial sphere/formation ratios as a function of either gravitation, density, or mass are equivalent: QME Mass-Energy Ж(g, ρ, m) ≡ ΛCDM ratios

5.4.1.1 RPG terms:

- R_C = GGC or SSIC core radius
- R_S = celestial sphere radius
- g_{max} = Maximum celestial sphere gravity given by: $g_{max} = 34.602 * g_S$
- g_S = celestial sphere external surface gravity or Newtonian gravity
- g_C = GGC or SSIC inner core surface gravity given by: $g_C = 23.837 * g_S$
- Ω_Λ = Dark Energy critical density parameter
- Ω_C = Dark Matter critical density parameter
- Ω_b = Baryon Visible Matter critical density parameter
- Ж = Total Mass-Energy (TME)
- Ж$_{DE}$ = Dark Energy
- Ж$_{DM}$ = Dark Matter

5.4.2 Radius of Gravity Generating Cores:

For all gravity generating celestial spheres and formations in the universe, the RPG research [15] indicates that all GGCs have radius: R_C = 17% ±3% of R_S.

SSIC/GGC Core Radius: $R_C \propto R_S \Rightarrow R_C = 0.17*R_S \pm 3\%$ (1)

5.4.3 Mass-Energy Flux dispersion range:

Gravitation flux radiates, disperses, and decays as a function of the Inverse Squared law ($1/r^2$).

5.4.4 Total Mass-Energy of Gravity Generating Sphere:

For all gravity generating celestial spheres in the universe, their maximum sphere-center gravity (g_{max}) can be calculated by multiplying the celestial spheres measured external surface gravity (g_S) and the square of the celestial sphere radius (R_S) divided by the SSIC/GGC inner core radius (R_C).

Total Mass-Energy: $g_{max} = [g_S * (R_S/R_C)^2]$ (2)

Figure-5: Total Mass-Energy from celestial sphere center

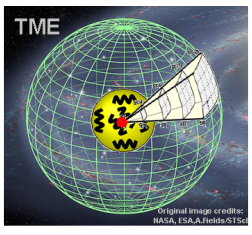


Figure-5: *Total mass-energy of any given celestial sphere can be computed as if its total mass-energy is concentrated at the sphere center (e.g. analogous to center of gravity).*

5.4.5 Surface Gravity of Gravity Generating Core:

For all gravity generating celestial spheres in the universe, their SSIC/GGC surface gravity (g_C) can be calculated by multiplying the celestial sphere's measured external surface gravity (g_S) times the square of the celestial sphere radius (R_S) divided by the SSIC/GGC inner core radius (R_C) minus one.

$$g_{C\,=}\, g_S * \; [(R_S/R_C) - 1]^2 \qquad (3)$$

5.4.6 Dark Energy or Passive Mass-Energy (PME):

For all gravity generating celestial spheres in the universe, their dark energy critical density ratio can be calculated by dividing SSIC/GGC inner core surface gravity (g_C) by the maximum celestial sphere gravity (g_{max}). To calculate dark energy of any gravity generating celestial sphere, divide equation (3) by (2):

$$\textbf{Dark Energy } (\Omega_\Lambda) = (g_C \div g_{max}) = 0.6889 \qquad (4)$$

Figure-6: SSIC surface emitting Dark Energy Attractive Flux

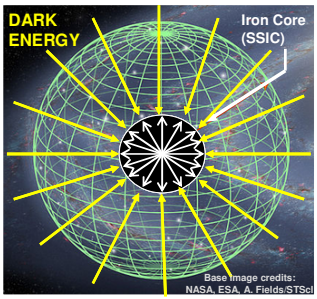


Figure-6: *SSIC surface emitting dark energy attractive flux traversing through the geological layers to the celestial sphere external surface and beyond to the cosmic-web.*

5.4.7 Dark Matter or Embedded Mass Energy (EME):

For all gravity generating celestial spheres in the universe, their dark matter critical density can be calculated by the following expression:

$$\textbf{Dark Matter } (\Omega_c) = [9.087*(g_S \div g_{max})] = 0.2626 \quad (5)$$

Figure-7: Dark Matter Repulsive Forces Embedded inside SSIC

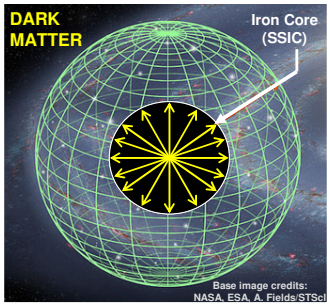


Figure-7: *Dark matter repulsive force embedded inside each Solid Spherical Iron Core (SSIC) counterbalances celestial gravitation via electron degeneracy pressures.*

Dark matter can also be calculated by subtracting Baryon Visible Matter (BVM) from the total Matter Mass-Energy (MME). Dark Matter = [MME – BVM]

5.4.9 Baryon Visible Matter (BVM):

For all gravity generating celestial spheres in the universe, their BVM critical density ratios can be calculated by dividing its sphere external surface gravity (g_S) by the SSIC/GGC inner core surface gravity (g_C) times the visible matter normalization multiplier of 1.1559. Dark matter constitutes 84.54% of total baryon mass that leaves visible mass of only 15.46% of the total mass [2]. However, we will apply our QME specific values: (Dark-Matter/Matter-Mass-Energy) = (26.26÷31.11) = 84.41%. Therefore, QME calculated baryon visible matter comes out to be 15.59%, which will be applied throughout this paper.

$$\textbf{BVM } (\Omega_b) = [1.1559 * (g_S \div g_C)] = 0.0485 \qquad (6)$$

6.0 Planet Earth's Normalized Mass-Energy QME/RPG Theoretical Critical-Density Ratios:

(i) For Earth's Total normalized Mass-Energy we have:
TME(Ω_{tot}) = (PME + MME) =1.0
where MME = [EME+BVM]
TME(Ω_{tot}) = (0.6889 + 0.3111) = 1.0

(ii) For Earth's Dark Energy (Passive Mass-Energy) from (4) we have:
PME: Dark Energy(Ω_Λ) = ($g_C \div g_{max}$) = 0.6889
PME: Dark Energy(Ω_Λ) = (233.76 ÷ 339.33) = 0.6889

(iii) For Earth's Matter Mass-Energy from ratio of (2) & (3) we have:
MME(Ω_m) = (g_{max} - g_C)/g_{max} = 0.3111
MME(Ω_m) = ((339.33 – 233.76) ÷ 339.33) = 0.3111

(iv) For Earth's Dark Matter (Embedded Mass-Energy) from (5) we have:
EME: Dark Matter(Ω_c) = [9.087 * ($g_S \div g_{max}$)] = 0.2626
EME: Dark Matter(Ω_c) = [9.087 * (9.807 ÷ 339.33)] = 0.2626

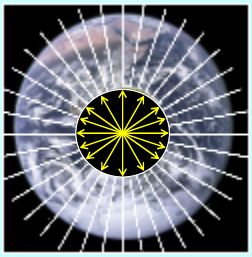
(v) For Earth's Baryon Visible Matter from (6) we have:
BVM(Ω_b) = [1.1559 * (g_S/g_C)] = 0.0485
BVM(Ω_b) = [1.1559 * (9.807 ÷ 233.76)] = 0.0485

(vi) Effective M-E Halo size (*elastic celestial sphere*): 4.88*$R_C \propto$ 17% R_S

The planet Earth QME and RPG Standard Analyses Results are summarized and compared against ESA Planck satellite measured data in the template below:

To conduct RPG analyses only three inputs are required: R_S = Celestial sphere radius (m), M_V = Celestial sphere mass (kg), and g_S = Celestial sphere Newtonian surface gravity (m/s^2). RPG analyses results for mass-energy density composition can also be expressed in units of gravitation, density, mass, and normalized percentage as summarized below:

Quantum Mass-Energy (QME) Standard Analysis - Earth		
SSIC Radius percent	17.00	%
Sphere Radius (R_S)	6.378E+06	m
SSIC Radius (R_C)	1084277.00	m
BVM sphere mass (M_V)	5.972E+24	kg
Universal G constant	6.674E-11	$m^3/kg\text{-}s^2$
SSIC core volume (V_C)	5.340E+18	m^3
QCC density (ρ_C)	14626.89	kg/m^3
SSIC mass (M_C)	7.810E+22	kg
SSG g_S	9.81	m/s^2
RPG - CSG g_c	233.76	m/s^2
RPG - SMG g_{max}	339.33	m/s^2
RPG - RSG	4.20	%
RPG - SFF	2.89	%
RPG - TME (ρ)	1.119E+06	kg/m^3
RPG - PME (ρ)	7.712E+05	kg/m^3
RPG - MME (ρ)	3.483E+05	kg/m^3
RPG - EME (ρ)	2.940E+05	kg/m^3
RPG - BVM (ρ)	5.429E+04	kg/m^3
RPG - TME (m)	5.977E+24	kg
RPG - PME (m)	4.118E+24	kg
RPG - MME (m)	1.860E+24	kg
RPG - EME (m)	1.570E+24	kg
RPG - BVM (m)	2.899E+23	kg



ME Density	QME	Planck	Delta
TME Ω_{tot}	100.00%	100.00%	0.00%
PME Ω_Λ	68.89%	69.11%	-0.22%
MME Ω_m	31.11%	30.89%	0.22%
EME Ω_c	26.26%	25.89%	0.37%
BVM $\Omega_{b\text{-}vis}$	4.85%	4.86%	-0.01%

Figure-8: *QME standard analyses results for Earth confirming each SSIC/GGC embeds 26.26% dark matter & generates and emits 68.89% dark energy*

7.0 DISCUSSION:

7.1 Dark Matter - nature, mechanism, and location:

Question often asked is where is the Dark Matter?

A short answer is, we are all sitting on top of it! Dark matter is the 26.26% mass-energy repulsive force embedded inside each SSIC/GGC. Dark matter counterbalances the gravitation by generating degeneracy pressure to avoid core collapse. Celestial pressure compacted SSICs/GGCs act as solid foundations or the seeds of their host planets. All SSICs/GGCs inner cores embed 26.26% dark matter which adds dark mass-energy to their visible mass.

The nature of dark matter is that it does not emit, absorb, or reflect light, nor does it interact with electromagnetic radiation, and it is totally invisible on the electromagnetic spectrum. It is the invisible non-electromagnetic mass-energy that is embedded inside each SSIC/GGC to maintain its structural integrity and to counterbalance gravitation by generating electron degeneracy pressures. Dark matter does not consist of any '*as-yet-undiscovered*' elementary particles.

Dark matter is the repulsive strong force emanating from protons and their resident down quarks. It is the Short Range Repulsive Strong Force that proportionally scales-up and scales-out as a function of celestial pressures. The location of embedded dark matter is inside the solid iron cores (SSICs/GGCs).

Dark matter mechanism inside the SSIC ^{56}Fe atoms corresponds to a one-to-one 'electron-proton-down-quark' ratio. Therefore, each SSIC embeds about 26%[2] dark matter repulsive force as electron degeneracy pressures to counterbalance gravitation, while also maintaining ^{56}Fe nuclei separation inside its highly compressed SSIC spherical lattice structure.

Dark matter critical density for any SSIC/GGC sphere in the universe can be calculated by simply dividing the Newtonian surface gravity by the maximum sphere gravity multiplied by a factor of about nine.

$$\text{Dark Matter } (\Omega_C) = [9.087 * (g_S \div g_{max})] \equiv (\rho_{cdm} \div \rho_{Crit}) = 0.2626$$

Where: g_S = Newtonian gravity
g_{max} = Sphere max gravity: $g_{max} = (34.602 * g_S)$
g_C = SSIC/GGC inner core surface gravity: $g_C = (23.837 * g_S)$

7.2 Dark Matter Thought Experiment :
Imagine few kids jumping up and down on top of a mattress. The mattress sits on top of a box-spring. Just like Earth's geological blanket layers that reside on top of Earth's SSIC core. The box-spring is designed to counterbalance the weight and the downward pressure forces applied by both the mattress and the jumping kids with an equal and opposite repulsive force. At the same time, it also has to exert internal sideways repulsive force to maintain the fixed space-separation between each spring present inside the box-spring lattice structure. In this manner, each SSIC embeds 26.26% mass-energy to counterbalance the celestial gravitation, uphold the electron degeneracy pressures, avoid core collapse, and maintain the iron core spherical lattice structural integrity to endure celestial time frames.

7.3 Dark Energy - nature, mechanism, and location:

Question often asked is, what is the nature of Dark Energy?

A short answer is, we are all totally immersed in it! The gravity we experience at the planet surface is the residual surface gravity from the 68.89% mass-energy attractive force emitted from the surface of the SSIC residing inside each host planet. All SSICs emit 68.89% dark energy flux from their core surfaces.

The nature of dark energy is such that it does not emit, absorb, or reflect light, nor does it interact with electromagnetic radiation, and it is therefore invisible on the electromagnetic spectrum. Therefore, dark energy has no permitivity (ε_0) and no permeability (μ_0) losses, through any medium. In fact, you can climb up to the top of Mount Everest with millions of tonnes of rock under your feet and still not escape dark energy or residual surface gravity. However, dark energy does interact gravitationally with normal matter. It interacts is like a passive spider's web that activates only when an object interacts with it. Dark energy effective mass-energy Halo size is always proportional to: $4.88 * R_C \propto 17\% * R_S$. Dark energy flux does not consist of any '*as-yet-undiscovered*' elementary particles.

The mechanism behind dark energy generation is the emission of the attractive force channeled from iron atom neutrons and their resident down quarks. It is the Long Range Attractive Strong Force that proportionally scales-up and scales-out. The location of dark energy is the spherical flux halo generated by each solid inner core (SSIC/GGC). This attractive force flux is emitted from the surfaces of SSICs/GGCs that transforms to celestial sphere surface gravity and further dilutes to establish cosmic-web in outer space.

Dark energy for any SSIC/GGC sphere in the universe can be calculated by simply dividing the SSIC/GGC surface gravity by the maximum sphere gravity, given by the expression:

$$\text{Dark Energy } (\Omega_\Lambda) = (g_C \div g_{max}) \equiv (\rho_\Lambda \div \rho_{Crit}) = 0.6889$$

The SSIC/GGC core surface gravity dissipates over distance by the inverse squared law that permeates through any matter or medium. For example, Earth's core surface gravity of 233.76 m/s^2 depletes down as a function of distance to a residual surface gravity of 9.81 m/s^2 on Earth's exterior surface. The Residual Surface Gravity (RSG) contributions from all of the celestial gravity generating spheres collectively forms the Space Flux Field (SFF) or the cosmic-web.

7.4 Dark Energy/PME Thought Experiment:
Imagine squeezing a car-wash sponge to a point where it squirts out 68.89% soapy water, retains 26.26% soapy water inside the sponge and the sponge itself weighs 4.85%. This represents the critical density composition of each gravity generating sphere or formation that matches the large-scale universe ΛCDM.

7.5 TME Thought Experiment:
Imagine designing a tall 100 story skyscraper with a solid iron foundation that has a mass-energy *'repulsive'* force requirement of 26.26% to withstand the building weight. A mass-energy *'attractive'* force requirement of 68.89% is needed to keep the skyscraper frame structure firmly attached to the foundation, and the remaining 4.85% mass represents all of the skyscraper visible materials.

7.6 Reconciliation of QME theory findings with static Cosmological Constant (Λ) and Quintessence with a dynamic Λ:

QME theory results clearly show dark matter as an embedded repulsive force and dark energy as an attractive force. In fact, dark energy is emitted from the Gravity Generating Core (GGC) surfaces which transforms to celestial sphere surface gravity at a radial distance of $4.88 * R_C$ and ultimately becomes the cosmic-web in the outer space. In the outer space dark energy is represented by energy density of vacuum or the cosmological constant (Λ).

In order to reconcile with both a static Λ universe plus observation and speculation-based accelerating expansion of the universe, one can assume Λ to be constant over the short human life-spans and dynamic over long cosmic time-scales. This allows for a static snapshot of Λ in the current epoch and a Quintessence cycle with a dynamic Λ for the cosmic time-scales.

(i) QME theoretical calculations provide a static Λ or critical density value of 8.55E-27 kg/m^3 [11] that practically matches the Planck satellite measured Λ or critical density of 8.62E-27 kg/m^3 [14]. Therefore, QME theory is in full agreement with a static Λ. Since Λ is associated with vacuum density and the cosmological constant has a negative pressure ($p = -\rho c^2$), which is known to cause the accelerating expansion of the universe.

(ii) Alternately, Quintessence requires a dynamic Λ over the long cosmic time-scales to justify metric expansion of the universe. By varying the Λ in QME/RPG analyses, we confirm dark energy and its subset gravity are inversely proportional to GGC radius [11]. As the GGC radius increases over celestial time-scales, dark energy/gravity and Λ values decrease. This decrease in dark energy/gravity allows the older galaxies on the edge to recede faster from us resulting in the accelerated expansion of the universe.

[2] *^{56}Fe SSICs are believed to have some contamination from other elements like Nickel. Therefore, percent Dark Matter (EME) fraction tends to vary somewhat around the ideal target of 26%.*

8.0 RESULTS:

8.1 QME Dark Matter and Dark Energy Normalized Results Summary for the Solar System:

By using the QME theory Reverse Path Gravity-scaling (RPG) methodology Equations 1 through 6, we can calculate the Solid Spherical Iron Core (SSIC) surface gravities and the sphere maximum gravity (g_{max}) for each of the solar system celestial objects including the sun, planets, and the moons. Since the Total mass-energy (TME) of each celestial object is normalized to unity, we can take the ratio of SSIC surface gravity (g_C) divided by the TME (g_{max}) of the celestial sphere to calculate its percent dark energy (Ω_Λ) critical density results. Similarly, we can apply equation (5) to calculate the dark matter (Ω_C), and equation (6) to calculate the Baryon Visible Matter (Ω_b). The QME/RPG results accurately match the ΛCDM composition results for the universe, also proving that the dark matter and the dark energy characteristics are identical in all celestial spheres. For detailed RPG Solar system dark matter and the dark energy results see Table-1 below:

Table-1 – Dark Matter and Dark Energy RPG Results for Solar System's[3] Planets, Sun, and the Moon

Solar System Gravity Generating Spheres	Surface gravity (gs)	Iron Core gravity (gc)	Maximum gravity (gmax)	Dark Energy Attractive M-E Ω_Λ	Dark Matter Repulsive M-E Ω_c	Baryon Visible mass Ω_b	Sphere Total Mass-Energy Ω_{tot}
Mercury	3.70	88.20	128.03	0.688901	0.262638	0.048452	100.00%
Venus	8.87	211.44	306.92	0.688909	0.262644	0.048453	100.00%
Earth	9.81	233.76	339.33	0.688887	0.262653	0.048456	100.00%
Mars	3.71	88.46	128.41	0.688887	0.262640	0.048454	100.00%
Jupiter	24.79	590.93	857.79	0.688898	0.262642	0.048453	100.00%
Saturn	10.44	248.86	361.25	0.688886	0.262640	0.048454	100.00%
Uranus	8.69	207.15	300.69	0.688915	0.262645	0.048453	100.00%
Neptune	11.15	265.79	385.81	0.688914	0.262645	0.048453	100.00%
Pluto	0.62	14.78	21.46	0.688723	0.262561	0.048451	99.97%
Moon	1.62	38.62	56.06	0.688905	0.262621	0.048449	100.00%
Sun	274.00	6531.44	9480.97	0.688900	0.262643	0.048453	100.00%
Overall Theoretical Critical Density Ratio Averages:				**68.89%**	**26.26%**	**4.85%**	**100.00%**

8.2 QME Dark Matter and Dark Energy Results Summary for the Solar System Moons and minor planets:

The QME/RPG results for the solar system moons match the ΛCDM composition results for the universe, proving that the dark matter and the dark energy characteristics are identical in all solar system moons. For detailed RPG dark matter and the dark energy results for the solar system moons see Table-2 below:

Table-2 – Dark Matter and Dark Energy RPG Results for Solar System's[4] Moons and minor planets

Solar System Gravity Generating Moons	Surface gravity (gs)	Iron Core gravity (gc)	Maximum gravity (gmax)	Dark Energy Attractive M-E Ω_Λ	Dark Matter Repulsive M-E Ω_c	Baryon Visible mass Ω_b	Sphere Total Mass-Energy Ω_{tot}
Earth - Moon	1.62	38.62	56.06	0.688905	0.262621	0.048449	100.00%
Jupiter - Europa	1.31	31.32	45.47	0.688806	0.262627	0.048457	99.99%
Jupiter - Callisto	1.24	29.44	42.73	0.688977	0.262665	0.048452	100.01%
Jupiter - Io	1.80	42.81	62.15	0.688817	0.262623	0.048456	99.99%
Jupiter - Ganymede	1.43	34.04	49.41	0.688929	0.263020	0.048521	100.05%
Saturn - Titan	1.35	32.23	46.78	0.688970	0.262266	0.048379	99.96%
Saturn - Rhea	0.26	6.29	9.13	0.688938	0.258804	0.047742	99.55%
Saturn - Tethys	0.15	3.48	5.05	0.689109	0.269941	0.049784	100.88%
Saturn - Dione	0.23	5.53	8.03	0.688667	0.260304	0.048038	99.70%
Saturn - Mimas	0.06	1.53	2.21	0.692308	0.246733	0.045294	98.43%
Saturn - Enceladus	0.11	2.69	3.91	0.687980	0.255673	0.047230	99.09%
Saturn - Iapetus	0.22	5.32	7.72	0.689119	0.262516	0.048414	100.00%
Uranus - Ariel	0.27	6.41	9.31	0.688507	0.262586	0.048470	99.96%
Uranus - Titanian	0.38	9.03	13.11	0.688787	0.262727	0.048477	100.00%
Uranus - Umbriel	0.20	4.77	6.92	0.689306	0.262659	0.048428	100.04%
Uranus - Oberon	0.35	8.25	12.00	0.687500	0.262037	0.048440	99.80%
Uranus - Miranda	0.08	1.88	2.73	0.688645	0.266315	0.049149	100.41%
Neptune - Triton	0.78	18.57	26.96	0.688798	0.262932	0.048514	100.02%
Pluto - Charon	0.29	6.87	9.97	0.689067	0.262522	0.048419	100.00%
Ceres	0.28	6.67	9.69	0.688338	0.262605	0.048486	99.94%
Eris	0.82	19.55	28.37	0.689108	0.262677	0.048445	100.02%
Overall Theoretical Critical Density Ratio Averages:				**68.89%**	**26.17%**	**4.83%**	**99.89%**

[3] *The surface gravity inputs in the Table-1 second column were obtained from the NASA Planetary Fact Sheet website.[20]*
[4] *The surface gravity inputs in the Tables-2 and 3 second column were obtained from the NASA Planetary Fact Sheet website.[20]*

8.3 QME Dark Matter and Dark Energy Results Summary for the all Major Celestial Formations in the Universe:

Beyond the planets, stars, and the moons, dark matter and dark energy critical density ratios for all the GGC formations can be calculated using the RPG methodology for all gravity generating formations such as the neutron stars, galaxies, black holes, and the universe itself. The QME/RPG results for the GGC formations match the ΛCDM composition results of the universe, proving that the dark matter and the dark energy characteristics are identical in all GGC formations in the universe. For detailed dark matter and the dark energy results for all of the GGC formations are provided in Table-3 below:

Table-3 – Dark Matter and Dark Energy RPG Results for all Major Celestial Formations and universe

Universe Gravity Generating Formations	Surface gravity (gs)	Core gravity (gc)	Maximum gravity (gmax)	Dark Energy Attractive M-E Ω_Λ	Dark Matter Repulsive M-E Ω_c	Baryon Visible mass Ω_b	Formation Total M-E Ω_{tot}
Sun	274.00	6531.44	9480.97	0.688900	0.2626	0.048453	100.00%
Earth	9.81	233.76	339.33	0.688887	0.2627	0.048456	100.00%
Moon	1.62	38.62	56.06	0.688905	0.2626	0.048449	100.00%
Neutron Star	1.24E+12	2.96E+13	4.30E+13	0.688372	0.2621	0.048385	99.88%
Milkyway Galaxy	3.51E-04	8.36E-03	1.21E-02	0.690909	0.2636	0.048493	100.30%
Stellar Black Hole	1.47E+12	3.52E+13	5.10E+13	0.690196	0.2619	0.048234	100.04%
Intermediate Black Hole	1.33E+11	3.16E+12	4.59E+12	0.688453	0.2633	0.048612	100.04%
Universe (model)	5.17E-12	1.23E-10	1.79E-10	0.688900	0.2628	0.048473	100.01%
Overall Theoretical Critical Density Ratio Averages:				**68.92%**	**26.27%**	**4.84%**	**100.03%**

Note:- Gravity Generating Cores (GGC) consists of: (1) Solid Spherical Iron Cores (SSIC), (2) Solid Spherical Neutron Cores (SSNC), and (3) Spherical Super Quark-gluon-plasma Cores (SSQC) with quark combinations as base fundamental particles.

8.4 QME Dark Matter and Dark Energy Results in units of Total Mass-Energy Density for the solar system:

Dark matter and dark energy results in units of total mass-energy density (ρ) kg/m^3 (dark+visible) for all of the solar system moons are summarized below in Table -4:

Table-4 – Dark Matter and Dark Energy RPG Results in units of Total Mass-Energy Density for the solar system

Solar System Gravity Generating Spheres	Dark Matter Density kg/m^3	Dark Energy Density kg/m^3	Total Mass-Energy Density - kg/m^3	Dark Energy (Attractive M-E) Ω_Λ	Dark Matter (Repulsive M-E) Ω_c	Baryon Visible mass Ω_b	Sphere Total Mass-Energy Ω_{tot}
Mercury	3.435E+05	7.607E+05	1.104E+06	0.6889	0.2626	0.0485	100.00%
Venus	3.320E+05	7.351E+05	1.067E+06	0.6889	0.2626	0.0485	100.00%
Earth	3.483E+05	7.712E+05	1.119E+06	0.6889	0.2626	0.0485	100.00%
Mars	2.475E+05	5.481E+05	7.956E+05	0.6889	0.2626	0.0485	100.00%
Jupiter	7.854E+04	1.739E+05	2.525E+05	0.6889	0.2626	0.0485	100.00%
Saturn	3.924E+04	8.688E+04	1.261E+05	0.6889	0.2626	0.0485	100.00%
Uranus	7.701E+04	1.705E+05	2.475E+05	0.6889	0.2626	0.0485	100.00%
Neptune	1.020E+05	2.258E+05	3.278E+05	0.6889	0.2626	0.0485	100.00%
Pluto	1.183E+05	2.620E+05	3.803E+05	0.6889	0.2626	0.0485	100.00%
Moon	2.111E+05	4.675E+05	6.786E+05	0.6889	0.2626	0.0485	100.00%
Sun	8.921E+04	1.975E+05	2.867E+05	0.6889	0.2626	0.0485	100.00%
Universe (model)	2.660E-27	5.891E-27	8.551E-27	0.6889	0.2626	0.0485	100.00%
Overall Theoretical Critical Density Ratio Averages:				**68.89%**	**26.26%**	**4.85%**	**100.00%**

8.5 QME Dark Matter and Dark Energy Results Comparisons with NASA WMAP studies & ESA Planck satellite measurements

The QME dark matter and the dark energy results for the solar system are compared against NASA WMAP and the ESA Planck satellite measure ΛCMD study results. The QME dark matter and dark energy results closely match the NASA WMAP studies within 3.24% mean error percent. In a similar comparison QME matches the latest ESA Planck satellite measurement data (2015) with a mean percent accuracy of 99.74%. See details of QME results comparisons with the NASA WMAP and ESA Planck satellite ΛCDM studies in Table -6 below:

Table-6 – QME Dark Matter and Dark Energy RPG Results Comparisons with NASA WMAP & ESA Planck Satellite studies[13][14]

Universe ΛCDM Critical Density Parameters	LAMDA CDM Ω	QME Results (%)	NASA WMAP (%)	Comparison Delta (%)	NASA WMAP Collaboration (%)	Comparison Delta (%)	ESA Planck (%)	Comparison Delta (%)
Dark Energy	Ω_Λ	***68.89***	72.10	***0.0445***	71.35	***0.0345***	69.11	***0.0032***
Cold Dark Matter	Ω_c	***26.26***	23.30	***-0.1270***	24.02	***-0.0933***	25.89	***-0.0143***
Baryon Visible mass	Ω_b	***4.85***	4.63	***-0.0475***	4.63	***-0.0475***	4.86	***0.0021***
Total Mass-Energy	Ω_{tot}	***100.00***	100.03	***0.0003***	100.00	***0.0000***	99.86	***-0.0014***
QME Theoretical vs Satellite Measurement Studies Comparison Mean Error (%):				***-3.24%***		***-2.66%***		***-0.26%***

9.0 CONCLUSION:

QME Composition for each Celestial Sphere mirrors ΛCDM Universe:

1. *Our research calculations prove that all gravity generating celestial spheres (i.e. stars, planets, moons) are embedded with Solid Spherical Iron Cores (SSIC) and celestial formations (i.e. neutron stars, galaxy centers) with Gravity Generating Cores (GGC), that contain 26.26% dark matter, generate 68.89% dark energy, and include 4.85% baryon visible matter such that their Total Mass-Energy (Ж) adds up to 100%.*

QME Results for the Solar System validate ΛCDM Universe:

2. *QME/RPG theoretically calculated mass-energy density composition result averages for the Solar System are 26.26% dark matter, 68.89% dark energy, and 4.85% baryon visible matter that accurately match the universe ΛCDM model's nominal results.*

QME Results Match Previous works' and Studies:

3. *QME/RPG non-relativistic theory based on Euclidean space produces dark matter and dark energy results that accurately match the universe mass-energy density composition results of the complex four-dimensional Einstein space-time, Friedman solutions, and the ΛCDM model. QME theory also reconciles with both static Λ and Quintessence.*

QME Results Match Satellite measurement study ΛCDM Results:

4. *QME/RPG theoretical calculation results for dark matter and dark energy match the satellite universe measurement studies from NASA WMAP, WMAP multi-year collaboration, and ESA Planck satellite measurement study with a mean percent accuracy of 99.74%.*

QME Defines Nature of Dark Matter & Dark Energy:

5. *QME/RPG theory confirms the nature of dark energy as an 'attractive force' which is emitted from the SSIC/GGC surfaces. Dark energy disperses as a function of the inverse squared law, transitioning to surface gravity at a distance of 4.88 times core radius (R_C) then further diluting to form the cosmic-web in outer space. The nature of dark matter is a 'repulsive force' embedded inside each SSIC/GGC that increases its mass-energy while contributing to its electron degeneracy pressures. It counterbalances the gravitation pressures to avoid core collapse while enabling celestial sphere constant rotational velocities.*

QME Describes Mechanisms behind Dark Matter & Dark Energy:

6. *QME mechanisms that produce dark energy and dark matter are the coexistent and proportional attractive and repulsive nuclear forces residing within the iron atom nucleons. The nucleon resident down-quark combinations channel proportional attractive and repulsive forces. These nucleon attractive and repulsive forces scale-up, scale-out, and collectively manifest as dark energy and dark matter within each SSIC/GGC.*

QME Discovers Specific Source Location of Dark Matter & Dark Energy:

7. *RPG method determines the source location of dark matter and dark energy to be the cores (SSICs/GGCs) with 17% ±3% radii that are embedded inside each gravity generating celestial sphere and celestial formation. Each SSIC/GGC embeds 26.26% dark matter, generates and emits 68.89% dark energy, which is distributed universally as ΛCDM.*

QME Quantum-scale to Large-scale validation with ΛCDM composition:

8. *Dark matter and dark energy critical density composition in the ΛCDM model specifically applies to the universe large-scale structure. However, QME/RPG results match the ΛCDM composition across the entire spectrum from the quantum-scale to the large-scale universe structure.*

Gravitation & Cosmic-web are Inverse Squared Law Extensions of DE:

9. *QME theory confirms that under celestial pressures nucleon resident down-quarks proportionally channel Strong Nuclear Force that scales-up and scales-out as dark energy. RPG calculations show dark energy transforms to residual surface gravity and further dilutes to form cosmic-web in outer space. Hence, there are only three fundamental forces in nature: electromagnetism, strong, and weak nuclear forces.*

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