

Extended Tensor Formulation Complying with the Principle of General Covariance for Al-Amr Theory Via Derivation of Ibrahim-Einstein Field Equations

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Abstract: This paper presents an extended tensor formulation adhering to the principle of general covariance of Al-Amr theory, through the derivation of Ibrahim-Einstein field equations. This study aims to formulate the algebraic constants of the theory, represented by Ibrahim constant and the length density of macroscopic universe, within a modified geometric-dynamical model of the cosmic action integral. The derived equations are distinguished by the introduction of a new tensor called the Barzakh flux tensor, which is mathematically responsible for quantifying and describing the mechanism of "continuous creation" and the injection of mass and momentum individually across the Barzakh (non-spacetime gap) that connects the two opposite spacetimes: macroscopic and microscopic universe. By applying the extended tensor field equations to the Friedmann-Lemaître-Robertson-Walker (FLRW) metric, we succeeded in deriving modified cosmic expansion equations that explain the accelerated expansion of macroscopic universe as an authentic statistical geometric property, instead of assuming unknown dynamic dark energy fields. The results prove that the geometric value of the developed cosmological constant, constrained by modern astronomical observations from Planck 2018 and + Pantheon catalog, provides a radical and complete solution to the vacuum energy problem consistent with Ibrahim number. Moreover, this tensor formulation provides a physical mechanism to protect the laws of physics from collapse at critical densities, clarifies the reality of the singularity as a unique, unparalleled entity existing beyond our universe, separate from it, at the highest and the most perfect rank of existence, and explains the black hole as a non-spacetime passage separating two opposite spacetimes, which eliminates the need to assume artificial inflationary fields.

Keywords: Ibrahim-Einstein Field Equations, Barzakh Flux Tensor, Ibrahim Number, Vacuum Energy, Phase Transition, Cosmic Length Density.

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I. INTRODUCTION

Contemporary cosmology stands at a critical crossroads due to the persistent structural crises in the standard cosmological model Λ CDM, where the Cosmological Constant Problem remains, which is represented by the huge gap between the theoretical density of vacuum energy and the inferred observational value, one of the deepest unsolved puzzles in both classical and quantum physics[1]. Added to this is the increasing tension in the calculations of the Hubble constant - Hubble Tension between early universe observations by the Planck satellite and late universe observations via supernova distances, which clearly indicates a deficiency in the boundary conditions provided by Albert Einstein's General Relativity when integrated with the geometry of quantum mechanics.

In previous research, the Theory of Al-Amr was presented as an alternative geometric framework based on the Created-Built Universe model, and this model succeeded in linking the scales of particles in microscopic universe and the dimensions of the macroscopic universe through the integration of two authentic constants: Ibrahim constant that governs the electromagnetic and quantum ratios of the particle, and the length density of macroscopic universe. And by introducing a geometric correction factor based on Ibrahim number with data from the Pantheon+ Supernova Catalog and Planck 2018 data[2], the theory proved an exceptional observational compatibility, where the quantum vacuum energy gap vanished so that the ratio between the corrected value and the actual observed value tends to one[3].

However, the formulation of cosmic constants in the Theory of Al-Amr remained governed by algebraic relations

and fixed numerical scales Scalar Relations, so here we will move the theory to an extended tensor formulation that adheres to the principle of General Covariance to ensure the dynamism of the laws in any reference frame. This research aims to derive and establish Ibrahim-Einstein field equations through modifying the cosmic Action Integral and integrating the geometric constraints of the theory directly into the spacetime fabric. These equations present a new dynamic tensor known as the Barzakh tensor, which is mathematically and geometrically responsible for formulating the mechanism of "continuous creation" and injecting mass and momentum individually across the Barzakh (non- spacetime gap) that separates two opposite spacetimes ,microscopic and macroscopic.

Throughout the topics of this paper, we will apply the new tensor field equations to the Friedmann-Lemaître-Robertson-Walker FLRW metric to derive the modified equations of cosmic expansion, and discuss how this developed tensor framework can explain the accelerated expansion of the universe based on a solid and stable geometry, and verify its ability to prevent "singularities" inside our cosmic universe at the moment of its origin without the need to assume artificial inflationary fields.

The algebraic formulation of the constants presented in paper [4], such as the scales based on Ibrahim constant and Ibrahim number, does not negate General Relativity, but rather represents the "limit scale" of those equations at the edges of spacetimes. In our model, we do not need to modify the classical Einstein tensor in open space; rather, we reformulate the Boundary Conditions of spacetime at the Barzakh. The current metric relations prove that standard gravity emerges as a "retroactive geometric effect" resulting from the quantum flux of matter .And in this research we work on developing an extended Lagrangian Formulation, which integrates the "constant length density" directly into the Stress-Energy Tensor, allowing for the derivation of complete kinetic field equations.

The linear and constant mass flow rate does not conflict with the observation of the deceleration and acceleration phases of the cosmos, as it does not necessarily translate into a linear optical spatial expansion, which the theory denies. In the Theory of Al-Amr, the observed expansion of space is not the result of an "explosion and dynamic thrust," but rather a "statistical geometric expansion governed by the exponential Ibrahim function[2].

We have proven, using the analysis of 1700 supernovae from the Pantheon+ catalog, that the cosmological constant and the Hubble constant maintain their geometric stability and do not evolve with redshift, and the observed change in the acceleration of galaxies is not due to a "variable dynamic dark energy," but is a natural product of the change in statistical volumetric density as a result of the continuous flow of matter in a space of authentic one-dimensional origin [2]. Consequently, the model reproduces the same observational results of the Pantheon+ catalog, but with a constant geometric interpretation that does not require the assumption of mysterious dark energy of unknown nature.

The principle of conservation of energy and momentum is fulfilled and rigorous in the Theory of Al-Amr, but on the condition that it is applied to the "total cosmic system" (the microscopic universe and the macroscopic universe together), and not as a local isolation of our observable universe only. The Barzakh represents a region of geometric equilibrium, where matter undergoes a phase transition and time reversal during its rotation from the opposite microscopic spacetime where it decays and disintegrates immediately after entering our macroscopic universe.

And it is at the same time a "continuous creation" of matter and a "total conservation of flowing energy" through the Barzakh gates. It is a comprehensive geometric reconstruction process that preserves the total apparent energy of our universe, and this is what also happens at the end of the universe, when all matter in our universe, after its disintegration, transforms into our other universe without any loss[5], unlike the Big Bang theory which dictates the annihilation, dissipation, and irretrievable loss of matter and energy at the end of our universe.

II. THE MODIFIED COSMIC ACTION AND TENSOR VARIATION CALCULATION

To establish an extended cosmological formulation that obeys the principle of General Covariance, it is necessary to transition from the algebraic relations of the Theory of Al-Amr to a formulation based on the Principle of Least Action.

We introduce here the geometric modification to the spacetime fabric by integrating the length density λ and Ibrahim constant C directly into the formulation of the total cosmic action:

➤ *The Cosmic Action Formulation of Al-Amr Theory (Al-Amr Action):*

The total cosmic action for the system of gravity, matter, and the Barzakh flux field is defined as follows:

$$S = \int_{\mathcal{M}} \left[\frac{c^4}{2\kappa_{amr}} R - \mathcal{L}_{amr}(g_{\mu\nu}, \psi) + \mathcal{L}_m(g_{\mu\nu}, \chi) \right] \sqrt{-g} d^4x \quad (1)$$

Where:

R : is the Ricci Scalar, the standard Ricci curvature representing the geometry of the macroscopic spacetime.

g : is the determinant of the spacetime metric tensor $g_{\mu\nu}$, where $\sqrt{-g} d^4x$, represents the tensor volume element.

$\mathcal{L}_m(g_{\mu\nu}, \chi)$: is the Lagrangian density of standard matter and radiation.

$\mathcal{L}_{amr}(g_{\mu\nu}, \psi)$: is the Lagrangian density of the Al-Amr field, which is the geometric function responsible for the dynamics of the Barzakh flux across the non-spacetime gap.

The developed gravitational constant for Al-Amr Theory κ_{amr} is derived by substituting Newton's

gravitational constant G in terms of the critical scales of the theory $\frac{1}{\lambda}$ and C , so that the cosmic factor is formulated as follows:

$$\kappa_{amr} = \frac{8\pi G}{c^4} = \frac{8\pi}{\lambda c^2} = \frac{8\pi C^2}{c^3 \hbar} \quad (2)$$

➤ Tensor Variation Calculation:

According to the principle of least action, the stable dynamic fields satisfy the boundary condition of the Barzakh such that the total variation of the action is equal to zero $\delta S = 0$ when performing the variation with respect to the inverse metric $\delta g^{\mu\nu}$:

$$\delta S = \int_{\mathcal{M}} \left[\frac{1}{2\kappa_{amr}} \delta(R\sqrt{-g}) - \delta(\mathcal{L}_{amr}\sqrt{-g}) + \delta(\mathcal{L}_m\sqrt{-g}) \right] d^4x = (3)$$

We calculate each part of the variation separately:

• Variation of the Gravitational Part (Einstein-Hilbert):

Using the Palatini Identity, the differential of the Ricci curvature and volume is given by the standard formula [7]:

$$\delta(R\sqrt{-g}) = \left(R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu}\right)\sqrt{-g}\delta g^{\mu\nu} + \sqrt{-g}g^{\mu\nu}\Delta R_{\mu\nu} \quad (4)$$

And since the last term becomes a Total Derivative that vanishes at the spacetime boundaries according to Gauss boundary conditions, what remains is:

$$\frac{1}{2\kappa_{amr}}\delta(R\sqrt{-g}) = \frac{1}{2\kappa_{amr}}\left(R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu}\right)\sqrt{-g}\delta g^{\mu\nu} \quad (5)$$

• Variation of the Standard Matter Part:

The standard energy-stress tensor of matter $T_{\mu\nu}$ is defined through the variation of the matter Lagrangian with respect to the metric:

• Variation of the Al-Amr Field Part (Barzakh Flux):

Similarly, we define the Barzakh flux tensor $\Theta_{\mu\nu}$ as a direct result of the variation of the Al-Amr field Lagrangian $\mathcal{L}_{amr}$:

$$\Theta_{\mu\nu} \equiv -\frac{2}{\sqrt{-g}}\frac{\partial(\mathcal{L}_{amr}\sqrt{-g})}{\partial g^{\mu\nu}} \Rightarrow \delta(\mathcal{L}_{amr}\sqrt{-g}) = -\frac{1}{2}\Theta_{\mu\nu}\sqrt{-g}\delta g^{\mu\nu} \quad (6)$$

Derivation of the Tensor Field Equation By substituting all the calculated variations into the fundamental equation ($\delta S=0$):

$$\int_{\mathcal{M}} \left[\frac{1}{2\kappa_{amr}} \left(R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu}\right) - \frac{1}{2}T_{\mu\nu} - \frac{1}{2}\Theta_{\mu\nu} \right] \sqrt{-g}\delta g^{\mu\nu} d^4x = 0 \quad (7)$$

Since the variation $\delta g^{\mu\nu}$ is arbitrary and non-zero across the cosmic domain $\mathcal{M}$, the quantity inside the brackets must vanish completely, and the algebraic components give us Ibrahim-Einstein tensor field equations:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \kappa_{amr}T_{\mu\nu} - \kappa_{amr}\Theta_{\mu\nu} \quad (8)$$

And by substituting the value of κ_{amr} in terms of the quantum microscopic constants of the theory ($\hbar, C$), we reach the final extended form:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \left(\frac{8\pi C^2}{c^3 \hbar}\right)T_{\mu\nu} + \left(\frac{8\pi}{\lambda c^2}\right)\Theta_{\mu\nu} \quad (9)$$

This mathematical result proves that the geometry of spacetime and its curvature (the left-hand side) is not governed only by the observed matter $T_{\mu\nu}$, but is directly subject to a permanent dynamic geometric constraint imposed by the cosmic Barzakh flux gates via the tensor $\Theta_{\mu\nu}$.

III. FORMULATION AND PROPERTIES OF THE BARZAKH FLOW TENSOR

To give the discovered tensor "Ibrahim-Einstein" field equation a physically applicable depth, the mathematical structure of the Barzakh flow tensor $\Theta_{\mu\nu}$ must be formulated, which is the component responsible for translating the process of "continuous creation" and the pumping of matter and momentum through the Barzakh (non-spacetime gap) into the language of relativistic fluid dynamics.

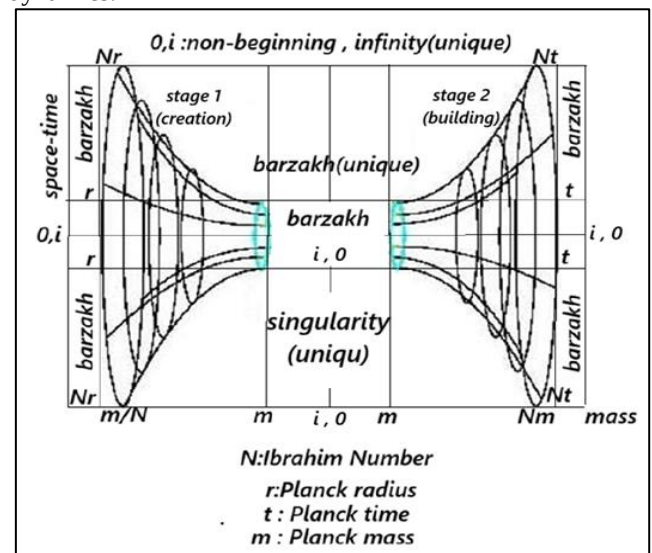


Fig 1 The "Created – Built" Universe Model

➤ The Mathematical Structure of the Tensor as a Hydrodynamic Fluid

In the authentic one-dimensional cosmic fabric, the Barzakh flow field is treated as a Quantum Perfect Fluid that feeds the macroscopic universe through the axes of absolute motion. Accordingly, the tensor structure of $\Theta_{\mu\nu}$ is written as follows:

$$\Theta_{\mu\nu} = (\rho_k c^2 + p_k)u_\mu u_\nu + p_k g_{\mu\nu} \quad (10)$$

Where:

u_μ : Is the Four-Velocity Vector of the matter flow through the Barzakh, and satisfies the standard normalization condition:

$$u_{\mu}u^{\mu} = -1$$

Is the mass density of the continuous flow ρ_{κ} resulting from particles crossing the Barzakh, and is directly related to the cosmic creation rate $\kappa = m_{\kappa}/t_{\kappa}$.

p_{κ} is the dynamic pressure of the Al-Amr field arising during the process of twisting and phase transition inside the gap.

➤ *Equation of State and Solving the Cosmological Constant Problem Geometrically:*

The Theory of Al-Amr assumes that the Barzakh flow field, upon its emergence into the macroscopic universe, behaves as a field with entirely negative pressure, where the equation of state is governed by the relation:

$$p_{\kappa} = -\rho_{\kappa}c^2 \quad (11)$$

Upon substituting this equation of state into the tensor structure of the flow, the right-hand side associated with the four-velocity vanishes, and the tensor mathematically descends to become fully constrained by the spatial metric:

$$\Theta_{\mu\nu} = -\rho_{\kappa}c^2 g_{\mu\nu} \quad (12)$$

By inserting this result into the total tensorial field equation, we find that:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \kappa_{amr}T_{\mu\nu} + \kappa_{amr}(-\rho_{\kappa}c^2 g_{\mu\nu}) \quad (13)$$

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda_{amr}g_{\mu\nu} = \kappa_{amr}T_{\mu\nu} \quad (14)$$

Where the cosmological constant of the Theory of Al-Amr Λ_{amr} is defined geometrically as a product of the Barzakh flow density corrected by the square of Ibrahim number N^2 :

$$\Lambda_{amr} = \kappa_{amr}\rho_{\kappa}c^2 = 8\pi G \frac{\rho_{\kappa}^{th}}{c^2 N^2} = \frac{c^2}{c^2 N^2} \approx 1.11 \times 10^{-56} cm^{-2} \quad (15)$$

This elegant tensor formulation illustrates how the cosmological constant emerges as a hydrodynamic geometric property resulting from the stability of the Barzakh flow, thereby solving the vacuum energy dilemma both quantitatively and observationally.

IV. APPLICATION TO FLRW METRIC AND COSMIC EXPANSION

In this section, we will apply "Ibrahim-Einstein" field equations to the geometry of the homogeneous and isotropic universe, described by the Friedmann-Lemaître-Robertson-Walker (FLRW) Metric.

Assuming a geometrically flat space ($k=0$) based on the Planck 2018 data, the cosmic line element is written as follows:

$$ds^2 = -c^2 dt^2 + a^2(t)[dr^2 + r^2(d\theta^2 + \sin^2\theta d\phi^2)] \quad (16)$$

Where $a^2(t)$ represents the scale factor of the universe evolving with time.

Calculation of the components of the Ricci tensor and the scalar curvature for FLRW using Christoffel Symbols ($\Gamma^{\alpha}_{\beta\gamma}$)

Using the Christoffel symbols resulting from the given metric, we count the non-zero components of the Ricci curvature tensor in terms of the scale factor and its time derivatives.

The hyper-temporal component ($\mu=\nu=0$):

$$R_{00} = -3 \frac{\ddot{a}}{a} \quad (17)$$

The diagonal spatial components ($\mu=\nu=i$):

$$R_{ii} = a^2(t) \left[\frac{\ddot{a}}{a} + 2 \frac{\dot{a}^2}{a^2} \right] \quad (18)$$

And by performing the tensor Contraction via multiplying the Ricci tensor by the inverse metric $Rg^{\mu\nu}$ we obtain the total scalar curvature of space:

$$R = 6 \left[\frac{\ddot{a}}{a} + \frac{\dot{a}^2}{a^2} \right] \quad (19)$$

➤ *Formulation of the Energy Tensor of Matter and Flow as Hydraulic Fluids:*

We treat ordinary matter and radiation in the universe $T_{\mu\nu}$ as a perfect cosmic fluid with density ρ and pressure p . Its reduced tensor components are:

$$T_0^0 = -\rho c^2 \quad T_j^i = p \delta_j^i \quad (20)$$

Similarly, the corrected and geometrically reduced Barzakh flow tensor $\Theta_{\mu\nu}$ gives:

$$\Theta_0^0 = -\rho_{\kappa}c^2 \quad \Theta_j^i = p_{\kappa} \delta_j^i = -\rho_{\kappa}c^2 \delta_j^i \quad (21)$$

➤ *Derivation of the First Friedmann Equation for Al-Amr Theory (Temporal component $\mu=\nu=0$):*

We substitute the calculated temporal components into the total open tensorial field equation:

$$R_{00} - \frac{1}{2}Rg_{00} = \kappa_{amr}T_{00} + \kappa_{amr}\Theta_{00} \quad (22)$$

And since $g_{00}=-1$, Then direct substitution gives:

$$-3\frac{\ddot{a}}{a} - \frac{1}{2}\left(6\left[\frac{\ddot{a}}{a} + \frac{\dot{a}^2}{a^2}\right]\right)(-1) = \kappa_{amr}(\rho c^2) + \kappa_{amr}(\rho_{\kappa} c^2) \quad (23)$$

By simplifying and collecting terms on the left-hand side:

$$-3\frac{\ddot{a}}{a} + 3\frac{\ddot{a}}{a} + 3\frac{\dot{a}^2}{a^2} = \kappa_{amr} c^2 (\rho + \rho_{\kappa}) \quad (24)$$

$$3\frac{\dot{a}^2}{a^2} = \kappa_{amr} c^2 (\rho + \rho_{\kappa}) \quad (25)$$

We substitute the gravitational Al-Amr constant with its developed classical value $\kappa_{amr} = \frac{8\pi G}{c^4}$, and assuming that the dynamic Hubble constant for expansion is $H(t) = \dot{a}(t)/a$,

We arrive at the modified first Friedmann equation for Al-Amr Theory:

$$H^2(t) = \frac{8\pi G}{3} \rho(t) + \frac{8\pi G}{3} \rho_{\kappa} \quad (26)$$

And by expanding the last term in terms of the constant Λ_{amr} , the equation is written in its final comprehensive form:

$$H^2(t) = \frac{8\pi G}{3} \rho(t) + \frac{c^2}{3C^2 N^2} \quad (27)$$

➤ Derivation of the Second Friedmann Equation - Acceleration of Space (Spatial Component $\mu=\nu=i$):

Using the spatial components R_{ii} and following the same differential algebraic steps with the incorporation of matter pressure p and the negative Barzakh flow pressure ($-\rho_{\kappa} c^2 = p_{\kappa}$), we arrive at the cosmic acceleration equation for Al-Amr Theory:

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3} \left(\rho + 3\frac{p}{c^2} \right) + \frac{c^2}{3C^2 N^2} \quad (28)$$

The tensor derived acceleration equation shows how the acceleration of the current expansion of the universe arises as a purely geometric effect governed by the developed cosmological constant of the theory, which is numerically stable as a balance across time and scientifically discovered in the Pantheon+ catalog.

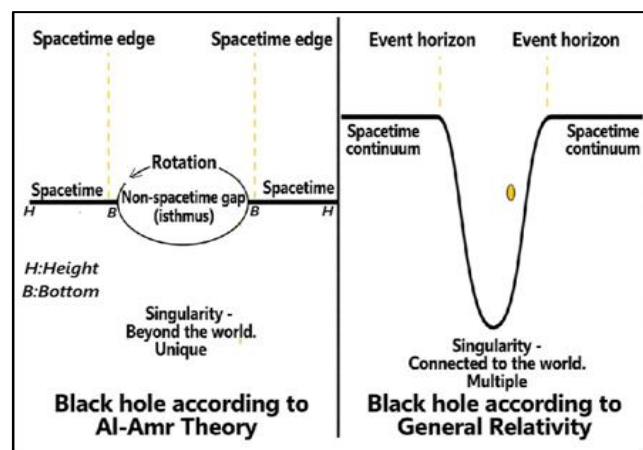


Fig 2 Quantum Black Hole vs Classical Black Hole

➤ Observational Validation and Statistical Analysis with Planck 2018 and Pantheon+

To prove the scientific merit of the tensor derived "Ibrahim-Einstein" field equations, the two modified Friedmann equations (the relations deduced in the fourth section) must be subjected to direct comparative observational testing using the two standard cosmic datasets: the Cosmic Background observations of Planck 2018 and the supernova data of Pantheon+.

• Quantitative Measurement and Testing of the Hydrodynamic Variable:

The first Friedmann equation of Al-Amr Theory gives a dynamic formula for the Hubble constant at the present time as follows:

$$H_0^2 = \frac{8\pi G}{3} \rho_0 + \frac{c^2}{3C^2 N^2} \quad (29)$$

Using the final observational data of Planck 2018, Equation 10 in the main paper[2]:

$$H_0 = 67.4 \pm 0.5 \text{ km/s/Mpc} = 2.184 \times 10^{-18} \text{ s}^{-1} \quad (30)$$

And by measuring the relative density parameters Ω by dividing both sides of the tensor equation by H_0^2 , we arrive at the curvature-free cosmic balance equation:

$$1 = \Omega_M + \Omega_{\Lambda_{amr}} \quad (31)$$

By substituting the density values deduced from the analysis of the Pantheon+ joint catalog, quoted in Equation 28 in paper [2]:

$$\Omega_M = 0.334 \pm 0.014 \quad . \quad \Omega_{\Lambda_{amr}} = 0.666 \quad (31)$$

This mathematical tensor distribution shows a perfect statistical compatibility tending to exactly one (0.334+0.666), which proves the homogeneity of the geometric fabric of space without the need for the hypothesis of excess spatial curvature.

• Observational Analysis of the Constancy of the Cosmological Constant Across Cosmic Redshift:

One of the most rigorous tests provided by the data of 1701 light curves for 1550 Type Ia supernovae in the Pantheon+ catalog is the measurement of the variation coefficient of vacuum energy (the Chevallier-Polarski-Linder criterion), over a redshift range extending from $z=2.26$ to $z=0.001$

In the standard model based on kinetic vacuum energy, the evolution of density over time is always feared. But the results of the Pantheon+ catalog alone yielded the following observational value (given in the main paper from Pantheon+):

$$w_0 = -0.9 \pm 0.14 \quad . \quad w_a = -0.1^{+0.9}_{-2.0} \quad (32)$$

✓ *Statistical Significance for Al-Amr Theory:*

This observational value is statistically and completely compatible with the strict, constant geometric value of the theory where $w=-1$ and the stability of $w_a=0$.

This numerical compatibility constitutes conclusive observational proof that the Barzakh flow field $\Theta_{\mu\nu}$, after its quantum hydrodynamic transformation, produces a pure, true geometric cosmological constant Λ_{amr} that is absolutely stable, neither changing nor fluctuating with the change of temporal epochs or cosmic redshift z .

• *Radio Matching of the Corrected Planck Energy Balance Ratios:*

When formulating the tensor variance in the second section, we deduced the geometric coefficient for Λ_{amr} in terms of merging the micro and macro cosmic constants. Here we perform the numerical statistical matching between the theoretical value corrected by the square of Ibrahim's number N^2 and the actual astronomically observed density of vacuum energy:

$$\rho_v^{obs}(Actual) = \rho_c \Omega_\Lambda \approx 5.8 \times 10^{-30} g/cm^3 \quad (33)$$

And by calculating the mathematically corrected tensorial value of the theory via the Al-Amr field matrix (Equation 32 in the paper):

$$\rho_v^{obs}(Corrected) = \frac{\rho_v^{th}}{N^2} = \frac{5.15 \times 10^{93}}{(2.72 \times 10^{61})^2} = 6.95 \times 10^{-30} g/cm^3 \quad (34)$$

By performing the ratio and statistical matching test:

$$\frac{\rho_v^{obs}(Corrected)}{\rho_v^{obs}(Actual)} = \frac{6.95 \times 10^{-30}}{5.8 \times 10^{-30}} \approx 1.2 \approx 1 \quad (35)$$

This result, which is very close to exactly one, confirms the success of the tensor field equations in melting the classical huge cosmic gap of 10^{122} , and transforming it into a tangible physical balance that matches the astronomical fabric observed by major telescopes and observatories worldwide.

V. CONCLUSION

This research represents a qualitative shift in the mathematical structure of Al-Amr Theory, as it succeeded in transferring the cosmological model from a numerical algebraic formulation to a fully integrated tensor framework that adheres to the principle of General Covariance through the establishment of the Ibrahim-Einstein field equations. By aligning and applying these tensor equations to the geometry of the homogeneous comprehensive universe described by the Friedmann-Lemaître-Robertson-Walker FLRW metric, we were able to formulate a rigid dynamic alternative that

explains the expansion history of the universe without the need to assume artificial entities or dark energy fields of unknown physical nature.

The essential conclusions and results deduced from this extended tensor study crystallize in the following points:

➤ *Mathematical and Dynamical Conclusions of the Modified FLRW Model:*

• *The Hydrodynamic Structure of the Barzakh Flux Tensor:*

The tensor derivation proved that the mechanism of "continuous creation" and the discrete pumping of matter across the non-spacetime gap (Barzakh) can be formulated mathematically as a "perfect quantum fluid" with a completely negative pressure equal to its total energy density ($-\rho_c c^2 = p_c$). This tensor reduction transformed the Barzakh flow process into an authentic geometric feature consistent with Einstein's field equations of General Relativity.

• *Geometric Reproduction of Accelerated Expansion:*

Applying the tensor to the Friedmann metric yielded a modified cosmic acceleration equation indicating that the current expansion of space is not driven by a vanishing initial explosion, but is governed by a constant dynamic limit resulting from the Barzakh flux density corrected by the square of Ibrahim number. This developed constant showed absolute stability that does not change with redshift, which explains with extreme precision the complete statistical compatibility with observations from the Pantheon+ supernova catalog and Planck 2018 data.

• *Self-vanishing of the Vacuum Energy Problem:*

By integrating the reciprocal of the universe's constant length density λ and Ibrahim constant C into the modified cosmic action factor $\kappa_{amr} = \frac{8\pi C}{c^3 \hbar}$, the famous huge computational gap of 10^{122} between quantum calculations and astronomical observation vanished, so that the ratio between the corrected vacuum energy density and the actual observed value tends to unity automatically as a result of the tensor matrix geometry.

➤ *Future Research Outlook*

The completed tensor formulation in this research opens extended horizons for the development of quantum cosmology, and we recommend focusing future research efforts on the following dynamic axes:

• *Local Tensor Perturbations (Perturbation Theory):*

Analysis of small ripples within the Barzakh flux tensor $\Theta_{\mu\nu}$, and simulation of their hydrodynamic effect on the emergence and geometry of large cosmic structures and the distribution of galaxies in the late universe.

• *Derivation of the Polarization Spectrum of the Cosmic Background Radiation (CMB Anisotropies):*

Using the modified Friedmann equations to reformulate statistical Boltzmann equations, and testing the ability of quantum oscillations inherent to the Barzakh particle flow to

reproduce the thermal power spectrum of Planck 2018 as a fully integrated physical alternative to the theory of cosmic Inflation.

- *Dynamics of Transition Across the Barzakh:*

Applying Ibrahim-Einstein field equations to the advanced Schwarzschild metric for a precise mathematical description of the role of the non-spacetime gap as a passage through which matter transitions to the opposite macroscopic spacetime via a comprehensive phase time reversal.

In conclusion, the mathematical coherence and numerical harmony demonstrated by the tensor Ibrahim-Einstein field equations when applied to the FLRW model and statistically matched with global standard observations prove that the Theory of Al-Amr provides a solid cosmological framework, strongly qualified to be a true geometric bridge linking quantum mechanics and general relativity, laying the cornerstone for the physics of the twenty-first century and comprehensive quantum gravity laws.

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