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Possible Solution for the Gauge Hierarchy Problem and Vacuum Catastrophe

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The two important problems, namely the 'gauge hierarchy problem' or 'fine-tuning problem,' and the problem of the 'vacuum catastrophe' or the 'cosmological constant problem,' pose significant challenges to our deeper understanding of both micro and macro-level energy systems. The methods of renormalization and supersymmetry (SUSY) are applied in both cases, either to fine-tune or to theoretically cancel out the energy. In this paper, we propose that, in reality, no energy gets cancelled out, contrary to SUSY, but instead remains unchanged. We demonstrate mathematically that the energy of a quantum state remains in a particular state to maintain its full potential, thus remaining undetected.

Following a dynamics of the fundamental quantum energy state, referred to as the "Like Potential Energy" (LPE) dynamics, we explain the nature of this undetectable quantum state. We have discovered that by keeping the area of the quantum phase space constant while increasing the energy of the Quantum Harmonic Oscillator (QHO), we may reach a situation where the vibration becomes extremely high, resulting in a high energy level in the QHO. However, the Quantum Oscillatory Energy (QOE) remains unmanifested, having no discernible impact on its surroundings.

As a result, we have developed a new wave equation and a tensor using the LPE dynamics.

Keywords: Vibration, Constant phase space area, Like potential energy, 5-vector Space-Time-Vibration continuum, Tapering existence, Consciousness principle

1 Introduction

The motivation behind this paper arose when the author discovered Like Potential Energy (LPE)[1] might hold the key to addressing two fundamental problems: the "gauge hierarchy problem" and the "vacuum catastrophe." Consequently, this paper provides a more detailed exposition of the LPE, elucidating how this new dynamic, coupled with a novel wave equation, can help us comprehend why a significant portion of energy remains undetectable in both the cases of the Higgs boson and Dark Energy (DE).

The prediction of the Higgs boson in 1964 marked a pivotal moment in particle physics, made possible through quantum calculations within Quantum Field Theory (QFT). The calculated mass of the Higgs boson from the Feynman propagator in QFT is approximately 10^{19} GeV, however experimental results indicate a significantly lower mass, around 125 GeV[2-8]. This stark disparity between the calculated and measured energy values posed a significant challenge.

To address this disparity, the renormalization method was employed[9], effectively reducing the large difference between the calculated and measured values. This process, known as fine-tuning, although not a true fine-tuning in the conventional sense, helped resolve the issue, leading to what is known as the "fine-tuning problem" or the "gauge hierarchy problem"[10-11].

In the realm of cosmology, measuring Dark Energy (DE) presents a significant conundrum. In quantum electrodynamics of Quantum Field Theory (QFT)[12], when applying the principles of Lorentz covariance and considering the magnitude of the Planck constant, we obtain an astonishingly large value of 10^{113} joules/m^3. However, in practice, we detect only a minuscule amount of DE[13]. This substantial discrepancy between calculated and measured energies poses a formidable challenge.

To bridge this gap, scientists employ methods such as particle-superparticle interactions (akin to SUSY) or renormalization to cancel out or adjust the immense energy difference. This maneuver attempts to grapple with the perplexing issue known as the "vacuum catastrophe" or the "cosmological constant problem." DE is often equated with vacuum energy in these scenarios.

Yet, a fundamental question remains: why is this cancellation or adjustment of such vast energy necessary? Is there a way to conceptualize that this undetectable energy persists but in a different state,

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rendering it unmeasurable? The Like Potential Energy (LPE) seeks to address this question and, through mathematical formulations, posits that before the Big Bang, infinite energy existed in a state similar to undetectable Higgs energy or DE, preventing it from manifesting into the observable universe we know today.

In this paper, we present a theory grounded in LPE dynamics that challenges the notion of energy cancellation in the cases of the Higgs boson and DE. Our theory suggests that fine-tuning is unnecessary, and the substantial energy involved remains uncancelled. Instead, this energy persists in an unmanifested state, eluding measurement through conventional methods. When it comes to the Higgs boson and DE, only a portion of their energy becomes manifest, while in a no-creation state, the entire energy remains in an unmanifested state, which we refer to as the LPE state.

Furthermore, our research reveals that the same matter we observe in the universe possesses a threefold nature: a fully unmanifested state of energy, a partially manifested state (as seen in the Higgs boson and DE), and a fully manifested state, as commonly measured through quantum observations. We delve into the mechanics of LPE dynamics to explain how energy within any energy-matter system can remain unmanifested and how even grossly detectable energy-matter can simultaneously possess this unmanifested aspect from an alternative perspective. According to LPE dynamics, applying the same line of reasoning, it becomes apparent that even a single particle can potentially host an infinite amount of energy within it.

We have also demonstrated within this framework that the LPE dynamics offers a prediction of a state in which unmanifested energy can extend to infinity, with an absence of any vibration within the Quantum Harmonic Oscillator (QHO). This particular state, characterized by the absence of vibration, has far-reaching implications, including the cessation of time and space, as any energy-matter entity must inherently exist within the realm of Space-Time-Vibration (STV).

This state of no-matter, which we have designated as the Consciousness Principle (CoP), possesses unique properties that diverge significantly from those of conventional matter. It is important to note that while the CoP's properties overlap with concepts often associated with metaphysics or philosophy[14], our paper has deliberately refrained from delving into metaphysical or philosophical derivations. Instead, we have adhered strictly to the principles of conventional quantum physics and mathematics, thereby grounding our findings within the realm of empirical and mathematical inquiry.

2 Quantum Harmonic Oscillator (QHO) and Like Potential Energy (LPE)

The Quantum Harmonic Oscillator (QHO) holds a central role in our understanding of the energy-matter system. Its energy can be calculated by transforming the classical spring Hamiltonian into its quantum counterpart, replacing "position" with "position operator" and "momentum" with "momentum operator," as outlined by P.A.M. Dirac in "The Principles of Quantum Mechanics"[15].

When we represent the QHO in phase space, we traditionally plot position on the x-axis and momentum on the y-axis, creating an ellipse that spans three position dimensions and three momentum dimensions. To simplify this complex picture, we often consider only one position dimension and one momentum dimension[15]. Moreover, in the context of relativity, where energy and momentum are interchangeable, we position oscillatory energy along the y-axis. Consequently, the phase space area of the ellipse becomes x.E.

However, it's crucial to recognize that quantum fluctuations in both position and momentum introduce uncertainty into our measurements. As a result, we cannot obtain a well-defined area for this ellipse due to the inherent limitations imposed by Heisenberg's uncertainty principle.

We establish a crucial boundary condition for our proposed LPE dynamics by maintaining the phase space area of the Quantum Harmonic Oscillator (QHO) as a constant. This boundary condition serves as the framework within which our theory operates. Typically, in standard scenarios, the phase space area is directly proportional to the energy of the QHO, meaning that when the QHO's energy increases, the phase space area expands accordingly.

Our hypothesis comes into play when dealing with finer states of energy, such as those found in both the Higgs boson and Dark Energy (DE). In these cases, we propose that the phase space area remains constant, a departure from the usual energy-dependent phase space area. This unique state aligns with the energy characteristics of the Higgs boson and DE, presenting a potential solution to the "gauge hierarchy problem" and the "vacuum catastrophe."

This transition between a constant phase area and an energy-dependent phase space area signifies the shift between unmanifested and manifested energy states, providing a compelling framework for understanding the behaviour of energy-matter systems.

2.1 Like Potential Energy (LPE) Dynamics

When we establish the phase space area as a constant, the Quantum Harmonic Oscillator (QHO) provides insights into the concept of unmanifested energy, which forms the core of LPE dynamics. As illustrated in Fig. 1, as we increase the energy of the oscillator, the ellipse representing the QHO's phase space shrinks along the position axis. This specific scenario, in which energy in the oscillator increases while the spatial amplitude (position) decreases due to a fixed phase space area, leads to a state where vibrational movement halts. This transition energy, remaining high but vibrational displacement approaching zero, results in an unmanifested energy state, as the oscillator no longer imparts effects observable through position-based measurements. The term “unmanifestation” is used here in the sense of undetectability or unobservability.

This hypothesis can be justified when, as a thought experiment, we raise the QOE to infinity. In this state, the vibratory position is completely zero (since the phase space area is kept always constant) which implies that the oscillation's vibration comes to a complete halt. The zero vibration in the QHO makes the state completely unmanifested, albeit with infinite energy. Thus, it is understood that, before reaching zero vibration, there may be many such unmanifested states operating under LPE dynamics.

2.2 Like Potential Energy (LPE) State

The LPE of the QHO, like many other quantum states, is typically in a discrete state. However, when we consider the LPE at the extreme of zero vibration and infinite energy, it enters a continuous state. This transition from discrete to continuous states is akin to what we observe with free particles in highly ionized states, where the energy state becomes continuous.

To visualize this transition, we can refer to Fig. 2, which complements Fig. 1. In Fig. 2, the tip of the triangle symbolizes infinite energy existing in a continuous state with zero vibration, showcasing the unique characteristics of LPE at infinite energy.

When we measure the energy state of a material object, like a piece of iron, from one perspective, we often perceive it as having a classical state of energy. However, when we delve deeper into the quantum realm, that same piece of iron exhibits a quantum state of energy. In our proposal, we suggest that there exists yet another, even deeper standpoint of measurement – the Like Potential Energy (LPE) state – for the same material. In this state, the energy level surpasses the conventional quantum state by a considerable margin. Remarkably, within the LPE state, this elevated energy remains unmanifested.

Moreover, if we consider the highest level of the LPE, where vibration approaches zero, the piece of iron enters a state of infinite and continuous energy. We symbolize this state with the tip of the triangle in Fig. 2, designating it as the Consciousness Principle (CoP).

In essence, Fig. 2 illustrates the various energy states of the same matter (matter M) as measured from different standpoints mentioned above. For instance, in the case of the Higgs boson, its position

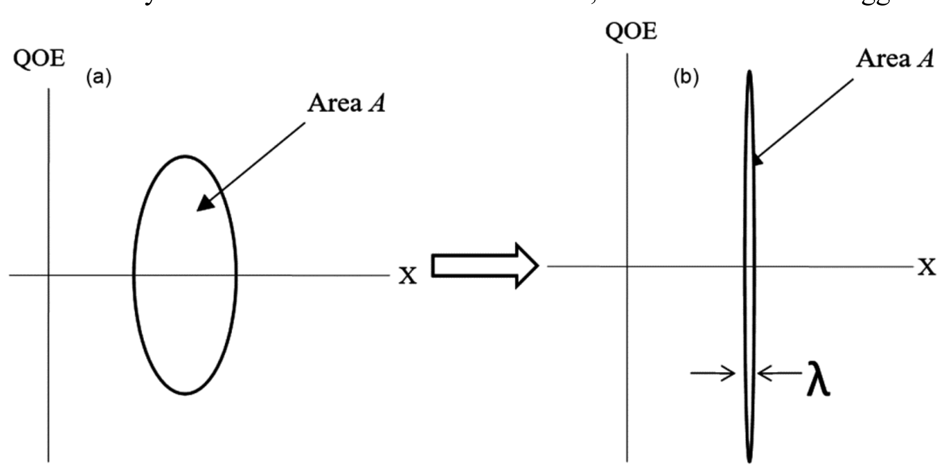

Fig.1 — (a) Phase space area A with oscillatory position x and QOE, and (b) Phase space area A with position x and more QOE

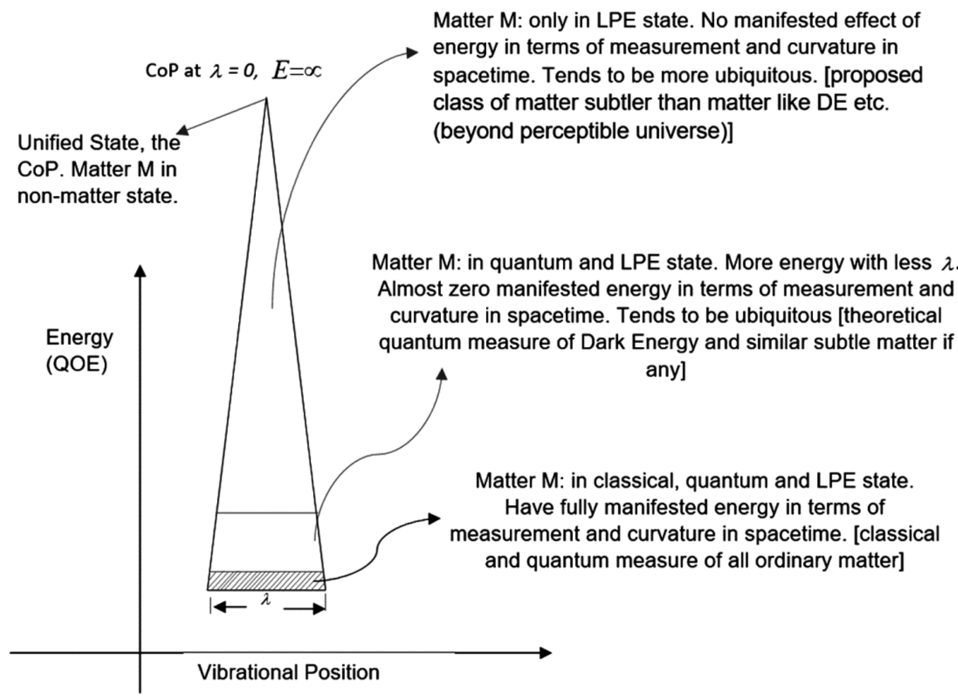

Fig. 2 — The tapering existence (taper triangle) of matter M following LPE dynamics

hovers just above the shaded portion of the triangle in Fig. 2, making it exceedingly challenging to measure its energy due to its unmanifested nature. Consequently, we can only measure the manifested portion of the Higgs boson (125 GeV), while the majority of the energy (10^{18} GeV) remains unmanifested, following the principles of LPE dynamics.

Similarly, in the case of Dark Energy, its position resides even higher above the shaded area of the triangle, where the unmanifested energy component is immensely high. The measured energy of Dark Energy is minuscule compared to its astronomically calculated energy (10^{113} joules/m^3). Here, too, the unmanifestation of energy occurs due to Dark Energy adhering to the principles of LPE dynamics.

In the context of this framework, *Like Potential Energy* (LPE) refers to a quantum state where the energy of the system continues to increase, while the vibrational displacement (position) decreases in such a way that the phase space area remains constant. Unlike conventional potential energy, which is generally dependent on positional displacement and results in manifest energy interactions, LPE is defined by its non-manifestation, that is, it does not produce observable curvature or measurable effects despite containing energy. Mathematically, it is governed by boundary conditions where the quantum phase space remains constant, and energy eigenstates approach a limit where vibration becomes negligible or zero. This LPE state is not just a theoretical construct, it generalizes the idea of "vacuum energy" and "suppressed quantum modes," suggesting that vast energy fields may exist without exerting gravitational influence, analogous to the behaviour of dark energy in cosmology.

3 Results

3. 1 The State of Unmanifestation: No Curvature due to Energy

In the case of Like Potential Energy (LPE), we posit that energy exists in a state that has no discernible effect on its surroundings. In essence, energy in this state remains entirely inert, devoid of any impact on its environment. This inert nature is why energy remains undetectable when measuring the energy of the Higgs boson. Similarly, in the case of Dark Energy (DE), the energy does not induce any fundamental curvature that would give rise to gravity.

However, it's important to note that the manifested Higgs boson or DE adheres to the standard characteristics of energy, making them measurable and observable.

As part of our proposal, we have developed an LPE tensor derived from the principles of LPE dynamics. This LPE tensor leads to a curvature that is zero, thus justifying the lack of manifested effects from the larger DE. We delve into the details of the LPE tensor in Section 6 of our research.

3.2 A New Equation under Constant Phase Space Boundary Condition

We have come up with the following wave equation (Eq. 1) applying the LPE dynamics. This equation tells how the state of a system under LPE evolves. The derivation of this equation has been worked out elsewhere [1] without normalization. Below, we will show the normalized equation.

$$\frac{\partial \psi}{\partial t} = \frac{\psi}{i\hbar}(x\rho - i\hbar\omega) \qquad \text{... (1)}$$

where, ρ= Energy density, ω = Rate of change of velocity w.r.t. position = $\frac{\partial \dot{x}}{\partial x}$

We may take the ρ to be constant while increase the energy of the QHO, to obtain the unmanifested effect in the QHO.

After normalizing Eq 1, we have:

$$\psi_1 = \frac{1}{\sqrt{2\pi}} e^{\frac{\rho t x}{i\hbar}} \qquad \text{... (2)}$$

When we apply the energy operator, $i\hbar\frac{\partial}{\partial t}$ to ψ_1 in Eq 2, we have:

$$i\hbar\frac{\partial \psi_1}{\partial t} = \rho x \psi_1 \qquad \text{... (3)}$$

where, $\rho x$is Energy Eigen value giving a 'definite energy' of the state ψ_1 at a given ρ and x

Similarly, by applying the momentum operator, $-i\hbar\frac{\partial}{\partial x}$ to $\psi_1$in Eq 2, we obtain:

$$-i\hbar\frac{\partial \psi_1}{\partial x} = -\rho t \psi_1 \qquad \text{... (4)}$$

where, ρt is momentum Eigen value giving a 'definite momentum' at a given ρ and t.

3.3 Vibration as the Fifth Dimension in Space-Time-Vibration (STV) Continuum

3.3.1 Vibration - The Starting Point of Cosmos

As discussed in the previous section, when the Quantum Harmonic Oscillator (QHO) reaches infinite energy under the LPE boundary condition, its vibration comes to a complete halt. From this observation, we can infer that when the vibration in the QHO ceases, time also ceases to exist. This is because any concept of time inherently relies on movement (vibration). Consequently, when vibration reaches zero, both time and space also become zero since spacetime forms a single continuous entity. This proposition suggests that vibration serves as the fundamental catalyst for the emergence of space and time.

In other words, vibration represents the very genesis of the entire cosmos. If the vibration of the QHO were to vanish entirely, it would lead to the disappearance of spacetime within the QHO, implying the cessation of the entire creative process.

In light of the intrinsic connection between vibration and spacetime, we propose that vibration serves as the fifth dimension, seamlessly extending the conventional 4-vector spacetime framework. According to Einstein's field equation of the General Theory of Relativity (GTR), spacetime constitutes a unified 4-vector continuum. However, as a natural consequence of acknowledging vibration as the fundamental driver of both space and time, we introduce the concept of a 5-vector space-time-vibration (STV) continuum.

In essence, this STV continuum represents an extension of Einstein's GTR field equation (as depicted in Fig. 3). By incorporating vibration as a fundamental component, we recognize that any alteration in one of the STV parameters will inevitably lead to changes in the other two. This profound insight reshapes our understanding of the interplay between spacetime and vibration within the fabric of the cosmos.

3.4 Extending Einstein's 4-Vector Spacetime Field Into 5-Vector Space-Time-Vibration (STV) Field

As discussed, vibration, as the cause of space and time, forms a continuum with space-time to form the 5-vector STV continuum. In this section, we will consider the tensor obtained from the LPE dynamics to include it as an extension of Einstein's 4-vector field.

By taking LPE tensor into consideration, S, the Energy-momentum Tensor Components, will have a

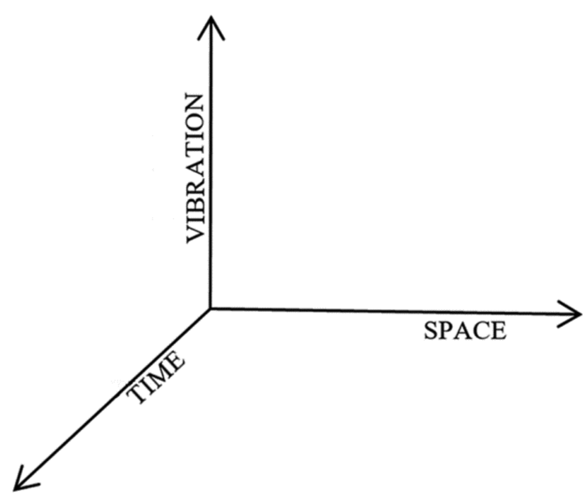

Fig. 3 — Space-Time-Vibration (STV) continuum

5-dimensional object forming STV continuum. In this 5X5 matrix, Vibration becomes the 5^{th} set of components in the matrix elements for the dimension from 0 to 4 (i.e.,$\rightarrow x^0, x^1, x^2, x^3, x^4$). We write the 5-vector matrix with the addition of LPE as follows:

$$\begin{bmatrix} S_{00} & S_{01} & S_{02} & S_{03} & S_{04} \\ S_{10} & S_{11} & S_{12} & S_{13} & S_{14} \\ S_{20} & S_{21} & S_{22} & S_{23} & S_{24} \\ S_{30} & S_{31} & S_{32} & S_{33} & S_{34} \\ S_{40} & S_{41} & S_{42} & S_{43} & S_{44} \end{bmatrix} = S_{\mu\beta}\partial^\mu \otimes \partial^\beta$$

$$= S_{00}\partial^0 \otimes \partial^0 + S_{01}\partial^0 \otimes \partial^1 + S_{02}\partial^0 \otimes \partial^2 + S_{03}\partial^0 \otimes \partial^3 + S_{04}\partial^0 \otimes \partial^4$$
$$+S_{10}\partial^1 \otimes \partial^0 + S_{11}\partial^1 \otimes \partial^1 + S_{12}\partial^1 \otimes \partial^2 + S_{13}\partial^1 \otimes \partial^3 + S_{14}\partial^1 \otimes \partial^4$$
$$+S_{20}\partial^2 \otimes \partial^0 + S_{21}\partial^2 \otimes \partial^1 + S_{22}\partial^2 \otimes \partial^2 + S_{23}\partial^2 \otimes \partial^3 + S_{24}\partial^2 \otimes \partial^4$$
$$+S_{30}\partial^3 \otimes \partial^0 + S_{31}\partial^3 \otimes \partial^1 + S_{32}\partial^3 \otimes \partial^2 + S_{33}\partial^3 \otimes \partial^3 + S_{34}\partial^3 \otimes \partial^4$$
$$+S_{40}\partial^4 \otimes \partial^0 + S_{41}\partial^4 \otimes \partial^1 + S_{42}\partial^4 \otimes \partial^2 + S_{43}\partial^4 \otimes \partial^3 + S_{44}\partial^4 \otimes \partial^4 \quad \text{... (5)}$$

where, ∂ is the basis vector (differential operator), and $\otimes$ is the notation for tensor product of two matrices.

The LPE energy-momentum can be obtained from the energy and momentum of the LPE field as in Eq (3) and (4), respectively.

Let us consider a vector V_β in pseudo Riemannian metric space with its β component with a small closed loop with dx^μ and dx^ν as its 2 sides in a 5-dimensional (STV) intrinsically curved space (Fig. 4 (a-b)). We will now make parallel transport of the vector V_β around the loop, starting at the point O in the dx^ν direction first and then in the dx^μ direction to come back to the point O (Fig. 4 (a)).

Let us make another parallel transporting of the same vector V_β around the same loop starting from the point O; but this time, the parallel transport should start first in the dx^μ direction, and then going along dx^ν direction to come back to the same point O (Fig. 4 (b)).

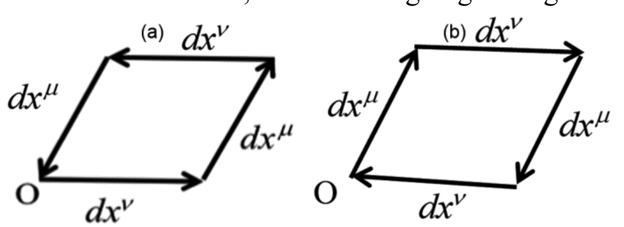

Fig. 4 — (a) Parallel transport starting from dx^ν direction, and (b) Parallel transport starting from dx^μ direction

In case of the space intrinsically curved, the result obtained in the 1^{st} parallel transport will not be the same as obtained in the 2^{nd} parallel transport. Because of intrinsic curvature, the vector V_β will be deflected by some angle at the same point O. Let this deviation be dv_λ

The first parallel transport of the vector V_β, starting in the dx^ν direction first, and ending at the point O is given by,

$$\nabla_\mu \nabla_\nu V_\beta = \nabla_\mu[\nabla_\nu V_\beta] \quad \text{... (6)}$$

where, ∇ is the covariant derivative operator of covariant tensor, $\nabla = \frac{\partial}{\partial x} - \Gamma$, where Γ the Christoffel symbol of 2^{nd} kind which has 1 upper index and 2 lower indices. When the operator Γ_μ acts on V_β, it returns $\Gamma^t_{\mu\beta}V_t$.

The second parallel transport of the vector V_β, starting in the dx^μ direction first, and ending at the point O, is given by,

$$\nabla_\nu \nabla_\mu V_\beta = \nabla_\nu[\nabla_\mu V_\beta] \quad \text{... (7)}$$

dv_λ, the deviation of the vector V_β is given by the following:

$$dv_\lambda = dx^\mu dx^\nu [\nabla_\mu, \nabla_\nu] V_\beta \quad \text{... (8)}$$

where, $[\nabla_\mu, \nabla_\nu]$ is the commutator of two covariant derivatives that act on V_β. This commutator is known as the Riemann tensor ${R_{\mu\nu}}^\lambda{}_\beta$ which is anti-symmetric with respect to μ and ν. Hence $g^{\mu\nu}{R_{\mu\nu}}^\lambda{}_\beta = 0$, where $g^{\mu\nu}$ is symmetric metric tensor.

[Note: If we Contract the indices λ and ν, we get the Ricci Tensor $R_{\mu\beta}$]

Now, the commutation relation between ∇_μ and ∇_ν is as follows:

$$[\nabla_\mu, \nabla_\nu] = \nabla_\mu \nabla_\nu - \nabla_\nu \nabla_\mu$$

Condition of a space being flat (no curvature) is when these two covariant derivatives commute with one other, in which case,

$$\nabla_\mu \nabla_\nu - \nabla_\nu \nabla_\mu = 0 \quad \text{... (9)}$$

We will now compute the complete set of components of these covariant derivatives acting on V_β in terms of metric tensors. We will then equate the commutation relation to 0 (as in Eq 9), since we have hypothesized that the energy-momentum tensor derived out of the LPE doesn't create any curvature despite having huge energy. Due to this reason, all the components of the Riemann tensor will be zero. Now:

$$\nabla_\mu \nabla_\nu V_\beta = \nabla_\mu \left[\frac{\partial V_\beta}{\partial x^\nu} - \Gamma^t_{\nu\beta} V_t\right] = \left[\frac{\partial}{\partial x^\mu} - \Gamma_\mu\right] \left[\frac{\partial V_\beta}{\partial x^\nu} - \Gamma^t_{\nu\beta} V_t\right] \quad \text{... (10)}$$

and

$$\nabla_\nu \nabla_\mu V_\beta = \nabla_\nu \left[\frac{\partial V_\beta}{\partial x^\mu} - \Gamma^t_{\mu\beta} V_t\right] = \left[\frac{\partial}{\partial x^\nu} - \Gamma_\nu\right] \left[\frac{\partial V_\beta}{\partial x^\mu} - \Gamma^t_{\mu\beta} V_t\right] \quad \text{... (11)}$$

We obtain the commutator by subtracting Eq (11) from Eq (10)

$$[\nabla_\mu, \nabla_\nu] V_\beta = (\nabla_\mu \nabla_\nu - \nabla_\nu \nabla_\mu) V_\beta = \nabla_\mu \nabla_\nu V_\beta - \nabla_\nu \nabla_\mu V_\beta$$

$$= \left[\frac{\partial}{\partial x^\mu} - \Gamma_\mu\right]\left[\frac{\partial V_\beta}{\partial x^\nu} - \Gamma^t_{\nu\beta} V_t\right] - \left[\frac{\partial}{\partial x^\nu} - \Gamma_\nu\right]\left[\frac{\partial V_\beta}{\partial x^\mu} -\right.$$

ΓμβtVt

$$= \left(\frac{\partial}{\partial x^\nu}\Gamma^t_{\mu\beta} - \frac{\partial}{\partial x^\mu}\Gamma^t_{\nu\beta} + \Gamma^\alpha_{\mu\beta}\Gamma^t_{\alpha\nu} - \Gamma^\alpha_{\nu\beta}\Gamma^t_{\alpha\mu}\right) V_t \quad \text{... (12)}$$

We'll now write all the Christoffel symbols[16] or Affine connection (all Γ in the Eq 12) in terms of metric tensors,

$$\Gamma^t_{\mu\beta} = \frac{1}{2} g^{st} \left[\frac{\partial g_{s\beta}}{\partial x^\mu} + \frac{\partial g_{s\mu}}{\partial x^\beta} - \frac{\partial g_{\mu\beta}}{\partial x^s}\right] \quad \text{... (13)}$$

$$\Gamma^t_{\nu\beta} = \frac{1}{2} g^{pt} \left[\frac{\partial g_{p\beta}}{\partial x^\nu} + \frac{\partial g_{p\nu}}{\partial x^\beta} - \frac{\partial g_{\nu\beta}}{\partial x^p}\right] \quad \text{... (14)}$$

$$\Gamma^\alpha_{\mu\beta} = \frac{1}{2} g^{q\alpha} \left[\frac{\partial g_{q\beta}}{\partial x^\mu} + \frac{\partial g_{q\mu}}{\partial x^\beta} - \frac{\partial g_{\mu\beta}}{\partial x^q}\right] \quad \text{... (15)}$$

$$\Gamma^t_{\alpha\nu} = \frac{1}{2} g^{rt} \left[\frac{\partial g_{r\nu}}{\partial x^\alpha} + \frac{\partial g_{r\alpha}}{\partial x^\nu} - \frac{\partial g_{\alpha\nu}}{\partial x^r}\right] \quad \text{... (16)}$$

$$\Gamma^\alpha_{\nu\beta} = \frac{1}{2} g^{m\alpha} \left[\frac{\partial g_{m\beta}}{\partial x^\nu} + \frac{\partial g_{m\nu}}{\partial x^\beta} - \frac{\partial g_{\nu\beta}}{\partial x^m}\right] \quad \text{... (17)}$$

$$\Gamma^t_{\alpha\mu} = \frac{1}{2} g^{nt} \left[\frac{\partial g_{n\mu}}{\partial x^\alpha} + \frac{\partial g_{n\alpha}}{\partial x^\mu} - \frac{\partial g_{\alpha\mu}}{\partial x^n}\right] \quad \text{... (18)}$$

After replacing the above Christoffel symbols (from the Eq 13 to Eq 18), in the Eq (12),

⇒

$$\left(\frac{\partial}{\partial x^\nu}\left[\frac{1}{2} g^{st}\left[\frac{\partial g_{s\beta}}{\partial x^\mu} + \frac{\partial g_{s\mu}}{\partial x^\beta} - \frac{\partial g_{\mu\beta}}{\partial x^s}\right]\right] - \frac{\partial}{\partial x^\mu}\left[\frac{1}{2} g^{pt}\left[\frac{\partial g_{p\beta}}{\partial x^\nu} + \right.\right.\right.$$

∂gpν∂xβ−∂gνβ∂xp+12gqα∂gqβ∂xμ+∂gqμ∂xβ−∂g μβ∂xq12grt∂grν∂xα+∂grα∂xν−∂gαν∂xr−12gmα ∂gmβ∂xν+∂gmν ∂xβ−∂gνβ∂xm12gnt∂gnμ∂xα+∂gnα∂xμ−∂gαμ∂x nVt=0

...(19)

Equation 19 is the equation of flat space under LPE dynamics. The space is flat though having large energy.

We get the Einstein's field equation for the curved space-time in the presence of energy-matter[17-18] as follows:

$$R_{\mu\beta} - \frac{1}{2} g_{\mu\beta} R = \frac{8\pi G}{c^4} T_{\mu\beta} \quad \text{... (20)}$$

where, $T_{\mu\beta}$ = energy-momentum tensor ,R = scalar curvature, $g_{\mu\beta}$ = metric tensor, $R_{\mu\beta}$ = Ricci tensor. Now, we get the 5-vector energy-momentum tensor from the Eq (5) due to LPE, which is denoted by $S_{\mu\beta}$ in the Space-Time-Vibration (STV) continuum. The LPE energy-momentum does not create any curvature (just as the vacuum energy doesn't create any curvature), as the LPE remains unmanifested, creating no gravity.

Now, taking LPE tensor into account, we have the following equation as an extension of the Einstein's field equation:

Thus the Eq (20) takes the following form:

$$R_{\mu\beta} - \frac{1}{2} g_{\mu\beta} R + \sigma g_{\mu\beta} = \frac{8\pi G}{c^4} T_{\mu\beta} + S_{\mu\beta} \quad \text{... (21)}$$

where, σ is an arbitrary constant implying the LPE tensor, $\sigma g_{\mu\beta}$ is metric tensor due to $S_{\mu\beta}$.

Equation 21 is an extended form of Einstein's 4-vector continuum field equation of GTR. This is the 5-vector STV continuum. We name this equation as the V-Tensor equation as follows:

$$V_{\mu\beta} = \frac{8\pi G}{c^4} T_{\mu\beta} + S_{\mu\beta} \quad \text{... (21(a))}$$

The 5 vectors are 1 time vector, 3 space vectors, and 1 vibration vector. This 5-vector can be alternatively thought of as 3-vector continuum constituting the Space-Time-Vibration (STV) triad.

Equation 21 tells us that when the STV has energy body other than the LPE, the energy-momentum tensor $T_{\mu\beta}$, as usual, creates curvature.

As we know, when $T_{\mu\beta} = 0$, $R = 0$, and $R_{\mu\beta} = 0$.

Yet the term $S_{\mu\beta}$ created due to LPE will continue to exist (eqn.21), but this $S_{\mu\beta}$, despite having large magnitude of energy, won't create any gravitational effect.

Thus at $R_{\mu\beta} = 0$, $T_{\mu\beta} = 0$, and $R = 0$, the Eq 21 changes as follows:

$$S_{\mu\beta} = \sigma g_{\mu\beta} \quad \text{... (22)}$$

From Eq 22, we get the geometry of LPE state.

We can postulate from Eq 21 that vast energy can exist in the vacuum field, without creating any gravitational effect. Thus, we obtained a 5-vector STV continuum with vibration as the fundamental cause of spacetime. With the consideration of LPE tensor we have put zero on the RHS (Eq 19), because LPE energy-momentum tensor doesn't create any curvature though having significantly large energy.

3.5 The Consciousness Principle (CoP) - The Corollary of LPE

While the term *Consciousness Principle* (CoP) represents the condition where the vibrational parameter of the Quantum Harmonic Oscillator (QHO) tends to zero while its quantum energy tends toward infinity, under a constant phase space constraint. From a physics standpoint, this implies a state beyond the standard spacetime fabric, a mathematically flat, non-curving energy field with no temporal or spatial extension. The CoP is the zero-vibration limit of the STV (Space-Time-Vibration) continuum, a proposed physical extension of the Einsteinian 4-vector field. It embodies a boundary condition in which all classical observables vanish, making it a candidate state for unobservable yet energetically significant phenomena, possibly even underlying vacuum fields or the source of observer-dependent quantum measurement effects.

In all energy-matter systems, there exist vibrating packets of energy, represented as Quantum Harmonic Oscillators (QHO). As previously discussed, under the framework of Like Potential Energy (LPE) dynamics, we observed that when energy within a QHO increases, the vibratory displacement decreases in a corresponding manner. Furthermore, we established that in the scenario where Quantum Oscillatory Energy (QOE) reaches infinity, vibration comes to a complete standstill, resulting in the disappearance of space and time. This state, where Space-Time-Vibration (STV) ceases to exist, is what we propose as the Consciousness Principle (CoP).

The CoP state transcends the boundaries of STV and, consequently, all material principles. In this state, despite the presence of infinite energy within the QHO, that energy remains motionless within the CoP. It represents a condition where all the STV limitations of the QHO vanish, as any limit is intricately intertwined with STV. Therefore, the CoP exists ubiquitously, devoid of any STV constraints.

As a result, we hypothesize that the CoP, this unique state, must possess properties distinct from those associated with matter. It represents a realm beyond the confines of conventional material principles, opening up intriguing possibilities for further exploration and understanding.

It is well-established that in quantum detection, the presence of an observer introduces a probabilistic element, rendering the quantum state inherently probabilistic rather than deterministic. Given that the CoP represents a unique state of oneness and infinity, the observer and the observed must be inseparable, forming a singular entity within the CoP. Consequently, there cannot exist two separate instances of the CoP. As a result, the CoP cannot be objectified or detected through conventional means, rendering it a continuous and indivisible state.

As discussed in Section 2.2, when viewed from the standpoint of the CoP, any material object loses its limits within the Space-Time-Vibration (STV) framework. The CoP, possessing infinite energy, can be seen as the underlying foundation of the entire universe. However, the material universe becomes observable to an observer only when viewed from a standpoint that differs from that of the CoP. From the STV standpoint, the infinite energy of the non-material CoP appears finite and material, owing to the act of observation.

In essence, this perspective sheds light on the dynamic relationship between the CoP and the observable universe, highlighting how the observer's standpoint influences the perception of energy and matter.

The CoP, by its very nature, cannot be objectively detected, yet it remains subjectively perceptible to the observer. It stands as the only entity that exists continuously, ubiquitously, and changelessly. It is "always" because it transcends the constraints of time, "everywhere" because it transcends the confines of space, and "changeless" because it transcends the fluctuations of vibration. In contrast, observations made within the framework of Space-Time-Vibration (STV) are inherently subject to change.

To convey the experience of the CoP to others is akin to describing an unknown and peculiar animal to someone using mere words. It is a challenge to express the CoP's essence accurately through language, just as describing an unfamiliar creature might be. However, it's important to note that many individuals can share the same subjective experience of the CoP. Moreover, this subjective experience of the CoP can be independently validated by multiple individuals. Unlike perceptions or inferences, this type of purely subjective experience falls into a distinct category that cannot be proved through conventional means.

It's worth emphasizing that the term "Consciousness," as commonly used today, differs significantly from the concept of the CoP explained here. In the modern context, "consciousness" typically refers to individual awareness, which is highly observer-specific[19-20].

While the term *Consciousness Principle (CoP)* represents the condition where the vibrational parameter of the Quantum Harmonic Oscillator (QHO) tends to zero while its quantum energy tends toward infinity, under a constant phase space constraint. From a physics standpoint, this implies a state beyond the standard spacetime fabric, a mathematically flat, non-curving energy field with no temporal or spatial extension. The CoP is the zero-vibration limit of the STV (Space-Time-Vibration) continuum, a proposed physical extension of the Einsteinian 4-vector field. It embodies a boundary condition in which all classical observables vanish, making it a candidate state for unobservable yet energetically significant phenomena, possibly even underlying vacuum fields or the source of observer-dependent quantum measurement effects.

4 Unifying Classical and Quantum Realms via LPE Dynamics

The Like Potential Energy (LPE) dynamics offers a powerful conceptual and mathematical framework that seamlessly bridges the classical and quantum domains. In classical mechanics, systems are governed by deterministic trajectories in phase space, with energy directly corresponding to measurable quantities such as velocity and position. However, in quantum mechanics, the behaviour of systems becomes inherently probabilistic, and the manifestation of energy is limited by principles like wavefunction collapse and uncertainty.

LPE dynamics introduces a novel perspective that transcends this dichotomy. By postulating a constant phase space area while allowing energy to increase, LPE dynamics reveals how energy can become progressively unmanifested (undetectable). In regular classical and quantum systems, increased energy typically results in increased observable effects (e.g., greater amplitude or velocity). In contrast, under LPE conditions, increased energy leads to reduced positional vibration, ultimately reaching a point of zero vibration with infinite energy, which is unmanifested in both classical and quantum senses.

This framework allows for a reinterpretation of classical matter, quantum fields, and even high-energy phenomena like the Higgs boson or Dark Energy. Classical systems can be seen as states where energy is fully manifested, quantum systems represent intermediate states with partial manifestation; and the LPE state encompasses the realm where energy exists without measurable effects, due to suppressed vibration.

Thus, LPE dynamics acts as a unifying theory across physical scales. It not only integrates the deterministic predictability of classical physics with the probabilistic constraints of quantum theory, but also points to a subtler substratum of reality—one where energy, though immense, remains dormant unless activated through vibration. This interpretation naturally leads to the Consciousness Principle (CoP), wherein the vibrational activity ceases entirely, and energy exists beyond measurable spacetime parameters.

By embedding LPE dynamics into both classical and quantum frameworks, this theory paves the way toward a continuum model of existence, from fully manifested classical matter to the unified non-material CoP, thereby enriching our understanding of the foundational layers of reality.

5 Philosophical Parallels in Vedantic Thought

These insights into the nature of reality find a profound resonance in the Vedantic philosophy as expressed by Swami Vivekananda. The idea of a unified, ever-present energy underlying all phenomena manifested or unmanifested is a recurrent theme in both LPE dynamics and Vedantic metaphysics. Swami Vivekananda described the universe as a “tapering existence”, where the gross material world transitions into subtler and subtler realms, culminating in the spiritual essence. This is strikingly similar to the LPE framework (Fig. 2), where energy remains unchanged, but its manifestation tapers as vibration approaches zero. He further remarked:

"There are laws, very fine, which are behind the physical laws, as we know. That is to say, there are no such realities as a physical world, a mental world, a spiritual world. Whatever is, is one. Let us say, it is a sort of tapering existence; the thickest part is here, it tapers and becomes finer and finer. The finest is what we call spirit; the grossest, the body. And just as it is here in microcosm, it is exactly the same in the macrocosm. The universe of ours is exactly like that; it is the gross external thickness, and it tapers into something finer and finer until it becomes God."[21].

Here, the 'God' referred to by Swami Vivekananda corresponds to the CoP described in this paper, representing the subtlest, all-pervading, and unmanifested state of existence. In another passage, Swami Vivekananda clearly shows the obvious connection between the modern science and ancient Vedanta philosophy. He exhorts:

"When the scientific teacher asserts that all things are the manifestation of one force, does it not remind you of the God of whom you hear in the Upanishads: "As the one fire entering into the universe expresses Itself in various forms, even so that One Soul is expressing Itself in every soul and yet is infinitely more besides?" Do you not see whither science is tending? The India proceeded through the study of the mind, through metaphysics and logic. The European nations start from external nature, and now they too are coming to the same results. We find that searching through the mind we at last come to that Oneness, that Universal One, the Internal Soul of everything, the Essence and Reality of everything, the Ever - free, the Ever - blissful, the Ever - existing. Through material science we come to the same Oneness"[22].

Based on the concept of Oneness, it can be concluded that the small world (microcosm) and the big world (macrocosm) are built upon the same plan, as suggested in the paper through the LPE dynamics. In the words of the Swami, *"The microcosm and the macrocosm are built on the same plan. Just as the individual soul is encased in the living body, so is the universal Soul in the Living Prakriti [Nature]--the objective universe*"[23]. Such Vedantic perspectives not only complement the LPE theory conceptually but also inspire a deeper inquiry into the nature of unmanifested energy, suggesting a convergence between the physical and the spiritual, the measurable and the experiential.

6 Conclusion

The LPE dynamics put forth in this theory offer valuable insights into some of the most perplexing questions in physics, such as the fine-tuning problem and the vacuum catastrophe anomaly. At its core, the LPE theory underscores the idea that as energy increases, the corresponding vibrational manifestation decreases—a fundamental principle that clarifies why the Higgs boson and Dark Energy (DE), despite containing vast energy, remain largely unmanifested, with only a small detectable portion.

This proposition of the LPE theory offers an alternative perspective that bypasses the need for theories like Supersymmetry (SUSY) or fine-tuning to explain these phenomena. It eliminates the need for fine-tuning in the Higgs boson scenario and provides a comprehensive understanding of the vacuum catastrophe.

Furthermore, the operation of this dynamics suggests that vibration plays a pivotal role in the formation of spacetime itself, essentially serving as the underlying cause of spacetime. This leads us to consider vibration as the fifth dimension, a fundamental constituent of creation that cannot be defined without Space-Time-Vibration (STV), just as space or time cannot be defined independently of STV.

The LPE dynamics also hints at a tapering existence of the universe, with vibrations in Quantum Harmonic Oscillators (QHO) gradually tapering from gross to subtle. As energy increases, vibrational manifestations decrease until reaching the state of the CoP, where vibrations cease entirely. The CoP represents the innermost core of matter, infinite in terms of space, time, and vibration. This framework suggests the existence of higher-energy bodies with substantial energy yet undetectable through ordinary means. It opens the door to considering the mind as a higher state of energy, potentially bringing it under the category of matter and subject to study within the realm of physics.

The perceptible and objectified universe is governed by the matter principle, with the substratum of the non-matter and subjective CoP. This binary framework, consisting of matter and CoP, comprehensively encompasses the entirety of existence, with no third principle of existence. The tip of the triangle in Fig. 2, representing the CoP, may hold the key to understanding the unified state that unifies the entire cosmos. Further exploration in this direction holds great promise for shedding additional light on this profound subject.

Looking ahead, the Like Potential Energy (LPE) framework opens several promising avenues for empirical investigation. While the current theory is largely conceptual and mathematical, future research could aim to experimentally probe systems that approach unmanifested energy states. For instance, high-frequency quantum harmonic oscillators in optomechanical setups might allow the detection of partially unmanifested energy via deviations in expected vibrational responses. Additionally, in the cosmological context, precision measurements of vacuum fluctuations and dark energy distribution may offer indirect evidence supporting LPE dynamics. The STV (Space-Time-Vibration) continuum model, which treats vibration as a fundamental dimension, could also inspire new directions in quantum gravity and field unification models. Incorporating the vibration factor into cosmological calculations — a step not previously undertaken — may lead to novel insights into our understanding of the cosmos. Though direct observation of the Consciousness Principle (CoP) is inherently constrained, the influence of unmanifested energy fields may manifest in subtle but measurable effects, warranting further interdisciplinary exploration across quantum physics, cosmology, and theoretical neuroscience.

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