The Universe Viewed Through Vibration

(Vibrational Cosmology)

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Abstract

This theory originates from the enigma of quantum non-locality. The phenomenon where two distant particles interact instantaneously, independent of the speed of light, contradicts conventional physical intuition.

This paradox led to a contemplation regarding the speed of light. I deeply analyzed the unit of velocity, m/s. This unit represents the distance traveled per unit of time. A velocity of 0 m/s implies no displacement; regardless of how much time passes, if there is no movement, the speed is 0 m/s.
However, in this conventional framework, time (t) becoming zero is mathematically prohibited in the denominator, as it would imply infinite velocity or distance.

This raised a pivotal question: "Why is velocity not treated with its inverse unit, like other time-dependent measurements?"
I considered the unit s/m (seconds per meter). In this framework, if time is zero, the value becomes 0 s/m, regardless of the distance. I realized that if time could essentially become zero, the non-locality of quantum entanglement—where distance becomes irrelevant—could be explained.

Amidst these inquiries, another thought emerged: "Why does frequency (vibration) possess the peculiar unit of 1/s?" It appeared as a unique unit composed solely of time. This led to a hypothesis: "What if we interpret it as s/1? What if time flows as a consequence of vibration?"

This line of thinking expanded to a fundamental question: "Does everything vibrate?" Upon investigation, I confirmed the physical fact that "all matter vibrates, and even light possesses its own frequency." Synthesizing this fact with my previous deductions, I arrived at a single, unifying conclusion:

"Vibration creates time."

This is the starting point of this theory. From this fundamental axiom, the theory proceeds to redefine space, time, and particles, and offers new explanations for General Relativity, Quantum Mechanics, Cosmology, and the unresolved mysteries of modern physics.

1. Introduction

As stated in the abstract, the First Axiom of this theory is: "Vibration creates time."

The Second Axiom is: "Vibration of space creates matter."
The existing Big Bang theory postulates that matter is created from "empty space" (nothingness) without a specific causal reason. However, this theory explains that particles are, in fact, "knots of space" formed by the vibrational energy of the J-Field.

Furthermore, this theory begins with the premise of a real, monistic field called the J-Field. This J-Field is the alpha and omega of our universe; everything we see, feel, and perceive originates from here.
The Third Axiom postulates that the J-Field possesses the physical properties of Planck Elasticity and Planck Density. It is argued that only with these specific properties can the observed gravitational constant (G) and the speed of light (c) be explained. However, it must be noted that this theory does not explain "why the J-Field possesses these specific characteristics."

Consider an analogy: I know the properties of the desk in front of me. It is made of white wood, it is sturdy enough to support a monitor and books, and it is rectangular in shape. However, I do not know where or how this desk was manufactured, nor do I know who made it with these specific materials or why.

For the same reason, while this theory defines the properties of the J-Field as Planck elasticity and density, it cannot explain the origin of these properties—who created them, why they were created, or why they are perfectly tuned to support our existence.

Admittedly, this approach carries the risk of circular reasoning.
This is because it uses Planck constants—which are derived from G and c—to conversely explain G and c. However, it is an undeniable fact that the Planck constants, derived from observational values, represent the fundamental constants of the universe. Thus, this should be regarded as a "Phenomenological Axiom."

This approach mirrors Wittgenstein's Ladder: we must use the ladder (observed values like G and c) to climb up (define the J-Field's properties with Planck constants), but once we have climbed up, we must throw away the ladder (derive constants anew from the field itself)**[1]**.

This theory is not intended to reveal the origin of the J-Field's characteristics.

Instead, it serves as a Meta-Theory, aiming to integrate various existing theories of the universe under the single phenomenon of "Vibration." Therefore, this theory does not deny existing theories.

Its purpose is to integrate them into a unified framework by reinterpreting the explanations of established physics through a new lens.

2. The Vibration Field (J-Field)

As mentioned in the introduction, this theory proceeds under the explicit assumption that a medium called the J-Field physically exists. The defining characteristic of this J-Field is that it is an elastic supersolid. A supersolid refers to a unique state of matter that possesses the structural properties of a solid while simultaneously exhibiting the fluidity of a liquid. It displays the distinct property of having particles arranged in a regular lattice, yet allowing for free internal flow**[2]**.

2.1 Characteristics of the J-Field

As a supersolid, the J-Field possesses Planck Elasticity and Planck Density. It functions as a frictionless supersolid, acting as an elastic body much like a rubber ball or a rubber sheet.
First, the fundamental values of the Planck units are as follows**[3]**:

Planck Mass	$m_p = \sqrt{\frac{\hbar c}{G}} \approx 2.176 \times 10^{-8}\ kg$
Planck Length	$L_p = \sqrt{\frac{\hbar G}{c^3}} \approx 1.616 \times\ 10^{-35}\ m$
Planck Time	$t_p = \sqrt{\frac{\hbar G}{c^5}} \approx 5.39 \times 10^{-44}\ s$

$\hbar$: Dirac Constant
G : Gravitational Constant
c : Speed of Light

The first characteristic of the J-Field is the elastic force, a prerequisite for any elastic body. It is equivalent to the Planck Force, with its value and unit as follows:

$$F_{p(J)} = \frac{m_p L_P}{t_p^2} \approx 1.21 \times 10^{44}\ N \tag{2.1.1}$$

Based on this, the Elastic Modulus (elastic force per unit area) of the J-Field is defined as below. This value is identical to the Planck Pressure.

$$P_{p(J)} = \frac{F_p}{L_p^2} \approx\ 4.633 \times 10^{113} \frac{N}{m^2} \tag{2.1.2}$$

This elastic modulus will later explain the Gravitational Constant and the Cosmic Inflation of the early universe.

The second characteristic is density. The J-Field possesses an ultra-high density equivalent to the Planck Density. Its value and unit are as follows:

$$\rho_{p(J)} = \frac{m_p}{L_p^3} = \frac{c^5}{\hbar G^2} \approx 5.155 \times 10^{96} \frac{kg}{m^3} \tag{2.1.3}$$

Calculating the wave propagation speed of the elastic J-Field based on these two properties yields the following result:

$$J_{wv} = \sqrt{\frac{P_p}{\rho_p}} = \sqrt{\frac{c^7/\hbar G^2}{c^5/\hbar G^2}} = c \tag{2.1.4}$$

This implies that the wave propagation speed of the J-Field, which permeates our entire universe, is precisely the speed of gravitational waves. This corresponds to the speed of light, the maximum speed limit of our universe. In the upcoming Chapter 6, we will explain why nothing can exceed the speed of light and why mass becomes infinite at that speed.

The third characteristic is vibration. True to its name, the J-Field possesses a fundamental frequency. This vibration corresponds to the inverse of Planck time, representing the maximum frequency in our universe.

Planck Frequency $$f_p = \frac{1}{t_p} = \sqrt{\frac{c^5}{\hbar G}} \approx 1.855 \times 10^{43}\ Hz$$

The amplitude of this vibration is the Planck Length. Although this minute vibration is frictionless, it does not adhere directly to particles but maintains a separation distance equivalent to the Planck length. This is analogous to an air hockey puck hovering on a cushion of air, moving without sticking to the surface.

Based on this, the vibration of the J-Field is defined as follows:

$$J_x(t) = L_p \cos\left(2\pi\, f_p\, t + \theta_0\right) \tag{2.1.5}$$

θ_0 : J-Field Fundamental Vibration

This implies that the J-Field is not a static medium at rest, but a highly dynamic medium vibrating at the fastest speed in the universe at the most fundamental scale, the Planck scale.

The fourth characteristic is vibrational synchronization resulting from its nature as a frictionless supersolid. This entails an instantaneous synchronization with the vibration of particles. When a particle vibrates, the J-Field synchronizes with that vibration to generate a wave. This wave is created and annihilated simultaneously with the particle or light.
This synchronization speed can be expressed as follows:

$$J(r,t) = \frac{\psi_p\left(t - \frac{r}{c}\right)}{4\pi r} \tag{2.1.6}$$

$J(r,t)$: Location and time of J-Field synchronization with particle
$\psi_p(t)$: Vibration state of the particle
r/c : Synchronization speed according to particle distance

This equation is described by introducing the Green's function of the three-dimensional wave equation**[4]**. It implies that the synchronization of the J-Field, triggered by the particle's vibration, occurs responsively at the speed of light.
Using the waves resulting from this synchronization, we will later explain particle duality and the principle of least time for light.

This explanation is analogous to a ball vibrating on a water surface: as the ball begins to vibrate, the surrounding water synchronizes with that vibration, generating ripples (waves).

This characteristic of direct synchronization with observation equipment means that the field reacts and generates the same vibration within Planck time the moment we move. Therefore, unless one can observe a timeframe smaller than Planck time, observation of the field itself is impossible. Furthermore, if the amplitude of a vibration is smaller than the Planck length, interaction with the J-Field becomes impossible.

This impossibility of interaction due to amplitudes smaller than the minimum amplitude explains the speed of light limit and the phenomenon of time stopping due to vibration cancellation.

The minimum vibration and synchronization of the J-Field render it invisible. The reason we feel no resistance despite its immense Planck density is due to its frictionless nature and the synchronization occurring at the speed of light in response to particle vibration. These factors make the direct observation of the J-Field medium fundamentally impossible.

$$\psi_P \approx \psi_J \qquad \Delta\psi \approx 0$$

This is analogous to a fish swimming in water; if the water were to move out of the way at the speed of light, the fish would feel absolutely no water resistance.
This unobservability could imply unfalsifiability. However, Chapter 11 of this theory presents methods for indirect falsifiability.
These characteristics are phenomena that can only occur if the medium of our universe possesses Planck unit values, originating from the observed values of G and c. Furthermore, this theory posits that, contrary to our perception, the J-Field and its properties make our universe dynamic, and that this space - filled with the medium of the J-Field - is the true protagonist of our universe.

In the next chapter, we will explain the Lagrangian of this J-Field, which generates our universe, space, time, and particles.

2.2 Lagrangian of the J-Field

The Lagrangian of the J-Field originates from the Einstein-Hilbert action of General Relativity and the Higgs potential equation**[5][6]**.

Initially, space exists at an energetically unstable peak with zero curvature.

$$\mathcal{L}_J = \frac{c^4}{16\pi G}R - \left(-\mu^2|J|^2 + \lambda|J|^4\right) \tag{2.2.1}$$

$R = 0$

Driven by this "Mexican hat" Higgs potential term, the energy of the J-Field descends from a high state to a lower state (phase transition), seeking a stable equilibrium point. This moment of descent marks the very instant of the Big Bang and the genesis of our universe.
Falling from the unstable peak, the J-Field initiates both expansion and vibration.

$$\mathcal{L}_J = \underbrace{\frac{c^4}{16\pi G}R}_{Gravitational\ Term} + \underbrace{\frac{1}{2}g^{\mu\nu}(\partial_\mu J)(\partial_\nu J)}_{Kinetic\ Term} - \underbrace{\left(-\mu^2|J|^2 + \lambda|J|^4\right)}_{Potential\ Term} \tag{2.2.2}$$

This Lagrangian describes the inception of the J-Field's vibration.
This vibration can be mathematically decomposed into amplitude and phase as follows:

$$\mathcal{L}_J = \frac{c^4}{16\pi G}R + \frac{1}{2}g^{\mu\nu}\left((\partial_\mu A)(\partial_\nu A) + A^2(\partial_\mu\theta)(\partial_\nu\theta)\right) - \left(-\mu^2|J|^2 + \lambda|J|^4\right) \tag{2.2.3}$$

A : Initial cosmic amplitude of the J-Field
θ : Initial cosmic phase of the J-Field

Now, applying the Principle of Least Action to this Lagrangian yields the following:

$$S_J = \int \left(\frac{c^4}{16\pi G} R + \frac{1}{2} g^{\mu\nu} \frac{1}{2} g^{\mu\nu} \left((\partial_\mu A)(\partial_\nu A) + A^2 (\partial_\mu \theta)(\partial_\nu \theta) \right) - \left(-\mu^2 |J|^2 + \lambda |J|^4 \right) \right) \sqrt{-g}\; d^3x\, d\theta \qquad (2.2.4)$$

It is a mechanism where unstable energy generates vibration, and the accumulation of this vibration induces curvature in space.

The foundation of this mathematical development integrates the equations of the two most successful theories in the history of physics. This signifies that this theory serves as a point of departure not by denying existing theories, but by reinterpreting them.

This departure begins with the premise that space consists of the medium known as the J-Field, and that the onset of this vibration is the origin of everything in our universe.

2.3 The J-Field Equation

By applying the Principle of Least Action to the Lagrangian presented in Chapter 2.2, we can derive both Einstein's gravitational field equations and the equation of motion governing the vibration.

For the gravitational equation, performing variation with respect to the spacetime metric ($g_{\mu\nu}$) yields a result identical to the conventional Einstein Field Equations.

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}(J) \qquad (2.3.1)$$

Next, to derive the equation of motion for the J-Field (J), we apply the Euler-Lagrange equation with respect to J, as follows:

$$\partial_\mu \left(\frac{\partial \mathcal{L}_J}{\partial (\partial_\mu J^*)} \right) - \frac{\partial \mathcal{L}_J}{\partial J^*} = 0 \qquad (2.3.2)$$

By organizing this equation into its respective kinetic and potential terms, the final equation of motion is obtained.

Derivative of the Kinetic Term $\quad \partial_\mu (g^{\mu\nu} \partial_\nu J) = \Box J$

Derivative of the Potential Term $\quad \frac{\partial V}{\partial J^*} = 2\mu^2 J - 4\lambda |J|^2 J$

Applying these organized kinetic and potential terms results in the following equation:

$$J = 2\mu^2 J - 4\lambda\, |J|^2\, J \qquad (2.3.3)$$

From the kinetic and potential terms of the J-Field Lagrangian, we can derive the Energy-Momentum Tensor ($T_{\mu\nu}$) for the gravitational equation. This is derived by performing variation with respect to the metric tensor. Representing the kinetic term in the form of a complex field yields:

$$\mathcal{L}_J = \frac{1}{2} g^{\mu\nu} (\partial_\mu J^*)(\partial_\nu J) - (-\mu^2\, |J|^2 + \lambda |J|^4) \qquad (2.3.4)$$

By varying this with respect to $g_{\mu\nu}$, it can be expressed as follows:

$$T_{\mu\nu}(J) = -2\frac{\partial \mathcal{L}_J}{\partial g^{\mu\nu}} + g_{\mu\nu}\mathcal{L}_J \tag{2.3.5}$$

Calculating the Lagrangian above yields the formula for the Energy-Momentum Tensor.

$$T_{\mu\nu}(J) = (\partial_\mu J)(\partial_\nu J^*) + (\partial_\nu J)(\partial_\mu J^*) - g_{\mu\nu}(-\mu^2|J|^2 + \lambda|J|^4) \tag{2.3.6}$$

In the equation above, the part denoted as $(\partial_\mu J)(\partial_\nu J^*) + (\partial_\nu J)(\partial_\mu J^*)$ represents the energy and momentum (pressure, flow, etc.) originating from the motion of the J-Field.
Furthermore, the part denoted as $g_{\mu\nu}(-\mu^2|J|^2 + \lambda|J|^4)$ includes both the Higgs potential and the kinetic energy of the J-Field, serving to maintain the consistency of the entire tensor.

In conclusion, this structure can be viewed as a cyclic feedback mechanism: the vibration of the J-Field induces curvature within itself, and this curved J-Field, in turn, influences the vibration.
Through this cyclic structure—where phenomena caused by the vibration of the J-Field exert influence back onto the J-Field itself, and the movement of the J-Field generates further vibration—the J-Field autonomously seeks and settles into a stable equilibrium point.

3. Fundamental Axioms of the Vibtational Cosmology

In Chapter 2, we defined the characteristics and the Lagrangian of the J-Field, the protagonist and origin of our universe. In this Chapter 3, we explain the First Axiom, "Time is a product of vibration; time exists only when there is vibration," and the Second Axiom, "Particles are created as topological knots of the J-Field."

3.1 First Axiom - Emergence of Time via Vibration

Philosophers and scientists have long pondered the question, "What is time?" In this theory, time is defined as the perception of change induced by vibration.
Conventionally, the mathematical formula for vibration (angular frequency) is defined as the phase change per unit of time:

$$\omega = \frac{d\theta}{dt}$$

This implies, "How much phase change occurred during a unit of time?"
However, this theory fundamentally redefines this relationship: "Vibration generates time."
Everything visible in our universe vibrates. There are no known particles or light that lack vibration. This serves as evidence that vibration generates time and enables our perception of reality. The emergence of time via vibration is described as follows:

$$dt = \frac{d\theta}{\omega} \tag{3.1.1}$$

Mathematically, this is a simple transposition swapping ω and dt , but the fundamental implication is profound. Time has traditionally been treated as an absolute value simply because its nature was unknown; however, in reality, time is a product of vibration. This equation implies that time changes according to the phase change of vibration, meaning time is not some mysterious, unknown entity.
Admittedly, this equation defies conventional wisdom. Since the dimension of vibration consists solely of the dimension of time (t^{-1}), this equation might appear tautological (essentially saying "time = time"). However, explaining the phenomenon of "vibration" is impossible without the physical quantity of "time."
Therefore, I ask that the meaning of this equation be accepted as an axiom: that the physical phenomenon of "Vibration" emerges what we perceive as "Time."

3.2 Second Axiom - Emergence of Matter via Vibrational Energy Condensation

If Section 3.1 explained time via vibration, we now proceed to explain the genesis of matter in the universe as time flows.

3.2.1 Condensation of Vibrational Energy

The inflation of the J-Field in the early universe induced random vibrations within the J-Field, i.e., within space itself. These random vibrations served as the foundation for matter creation. The vibrations of the early universe can be expressed as the sum of numerous plane waves, represented by a Fourier series:

$$J(\vec{x}, t) = \sum_{\vec{k}} A_{\vec{k}} \, cos\left(\vec{k} \cdot \vec{x} \, - \omega_{\vec{k}} \, t \, + \theta_{\vec{k}}\right)$$

$\vec{k}$: Sum of plane waves in all directions

This equation indicates that the J-Field of the early universe was not a single orderly wave, but a chaotic and disordered state composed of the sum of countless waves. These chaotic spatial vibrations generated waves through their respective vibrational energies, leading to superposition and numerous constructive interferences.

$$J_{total} = J_1 + J_2 + J_3 + \cdots$$

These superimposed waves formed localized peaks of high-energy waves. The energy density is proportional to the square of the vibration's amplitude and its rate of change:

$$\epsilon \propto (\partial_t J)^2, (\nabla J)^2$$

This proportionality to the square implies that constructive interference with the surroundings can cause energy concentrations tens, hundreds, or even thousands of times greater. When this concentration of energy exceeds a certain threshold, a particle is created.

The J-Field, or the vibration of space, creates particles through concentrated energy. The equation of motion in this theory can be divided into two parts: a linear restoring force and a nonlinear confinement force.

$$J = \underbrace{2\mu^2 J}_{\substack{linear \\ restoring\ force}} - \underbrace{4\lambda\, |J|^2\, J}_{\substack{\text{nonlinear} \\ \text{confinement force}}}$$

Due to the correlation between this linear force and nonlinear force, particles are generated only at high energy levels caused by the concentration of vibrational energy.

In this equation, under low-energy, quiescent conditions, the magnitude of the J-Field, $|J|$, is minimal. Consequently, the $|J|^2$ term in the equation approaches zero, rendering the nonlinear confinement force negligible. In this low-energy regime, the linear restoring force term dominates; thus, energy disperses, behaving as a conventional wave.

However, as the J-Field reaches a high-energy state and the amplitude $|J|$ increases significantly, the $|J|^2$ term grows exponentially, causing the nonlinear confinement force to overwhelm the linear restoring force. This powerful nonlinear confinement force prevents energy from propagating outward, exerting a strong condensing force that pulls it inward. This manifests the energy in the form of a knot.
The energy trapped by this knot cannot disperse and becomes localized, condensed energy. This condensed energy manifests as mass according to $E = mc^2$

This is precisely what constitutes a particle.

The creation of this particle involves trapping the vibrational energy of the J-Field, resulting in a phase transition of vibrational energy from a high-energy state to a lower-energy state. This can be explained using the low-energy approximation of vibration.
We begin with the equation of motion for the J-Field. Assuming a flat universe, the equation is described as follows:

$$\frac{1}{c^2}\frac{\partial^2 J}{\partial t^2} - \left(\frac{\partial^2 J}{\partial x^2} + \frac{\partial^2 J}{\partial y^2} + \frac{\partial^2 J}{\partial z^2}\right) = 2\mu^2 J - 4\lambda |J|^2 J \qquad (3.2.1)$$

Here, the left-hand side describes the wave of the J-Field propagating through time(t) and space (x, y, z) , while the right-hand side forces the formation of a stable knot representing the particle.
When this equation of motion is evolved over time and space, it can be interpreted as follows:

$$\frac{\partial}{\partial t} \to 0 \qquad\qquad \nabla \to 0$$

$$0 - 0 = 2\mu^2 J - 4\lambda |J|^2 J$$

This equation, evolving through time and space, eventually reduces to a form where explicit time and space dependence vanish, describing only the stable state of the field.

The solution to this equation can be interpreted in two ways.

$$J = 0 \qquad\qquad |J|^2 = \frac{\mu^2}{2\lambda}$$

These two solutions serve as a determinant equation: depending on the level of vibrational energy condensation, they decide whether a particle can be created or if the energy will disperse in the form of vibrations. If the energy is sufficiently high, it can remain in the form of a particle; if the energy is insufficient, it disperses in the form of a wave.
We can explain the mechanism of particle creation by treating this equation of motion as a progressive time-evolution equation.

$$\frac{1}{c^2}\frac{\partial^2 J}{\partial t^2} = \left(\frac{\partial^2 J}{\partial x^2} + \frac{\partial^2 J}{\partial y^2} + \frac{\partial^2 J}{\partial z^2}\right) + 2\mu^2 J - 4\lambda |J|^2 J$$

$$\frac{\partial J}{\partial t} = \underbrace{\alpha \nabla^2 J}_{Diffusion\,Term} + \underbrace{\beta F(J)}_{Particle\,Knot\,Term} + \underbrace{\delta A(J)}_{Asymmetry\,Term} \tag{3.2.2}$$

The Diffusion Term, represented by $\left(\frac{\partial^2 J}{\partial x^2} + \frac{\partial^2 J}{\partial y^2} + \frac{\partial^2 J}{\partial z^2}\right)$, describes energy diffusion. If the local energy is higher than that of the surroundings, it tends to flow outward to equalize with the surrounding energy. Consequently, if the condensed energy is low, this term prevents knot formation, causing the energy to diffuse into the surrounding space.

The Particle Knot Term, represented by $2\mu^2 J - 4\lambda\, |J|^2\, J$, describes the formation of the particle knot. Within this, the $2\mu^2 J$ creates instability when $J = 0$, causing explosive amplification of the vibration. The $-4\lambda\, |J|^2\, J$ acts as a confinement term; it prevents the vibration from growing infinitely and fixes it at a specific magnitude (J_0), thereby stabilizing the particle knot.

The Asymmetry Term represents the asymmetry of the particle, which signifies rotation or vibration (spin).
To describe the process of particle formation within the second-order wave equation, assuming the vibration of the J-Field and the transformational change into a particle, we can express it as follows:

$$J(x,t) = \psi(x,t) \cdot e^{-i\omega t}$$

$\psi(x,t)$: Deformation into a particle knot
$e^{-i\omega t}$: Fundamental vibration (phase) of the J-Field

Differentiating this equation twice with respect to time yields:

$$\frac{\partial^2 J}{\partial t^2} \approx e^{-i\omega t}\left(-\omega^2 \psi - 2i\omega \frac{\partial \psi}{\partial t} + \cdots\right)$$

Here, if we approximate the $(\partial^2 \psi)/(\partial t^2)$ term as negligibly small, only the first-derivative term $\partial\psi/\partial t$ remains.

$$i\frac{\partial\psi}{\partial t} = -\frac{1}{2\omega}\nabla^2\psi + F(\psi)$$

Here, by rearranging the term containing the imaginary unit i to the right-hand side, an imaginary component emerges. This imaginary term manifests as the physical property of rotation or phase evolution.

$$\frac{\partial J}{\partial t} \approx \alpha\nabla^2 J + F(J) + i\frac{\partial J}{\partial t}$$

$$i\frac{\partial J}{\partial t} = \delta A(J) \tag{3.2.3}$$

The second-derivative term is reduced to a first-derivative term. During this reduction process, the imaginary term representing the phase change is separated. This constitutes the Asymmetry Term.

The derivation process of this equation describes the genesis of a particle.
By describing the phenomenon where the space we perceive (the J-Field) becomes knotted due to its own vibration, this nonlinear equation signifies that particles are manifestations emerging directly from the J-Field.

3.2.2 Particle Tensor Equation

Section 3.2.1 demonstrated that particles can be knotted and manifest due to the vibrational energy of the J-Field. However, this scalar equation, which addresses only the magnitude of energy, is limited in explaining the specific characteristics of particles. The space we perceive is three-dimensional. Therefore, particles must also be described with three-dimensional twists and structures. We introduce the concept of tensors—originally employed by Einstein to explain three-dimensional gravity—to describe the internal structure of particles.

In this framework, a particle is defined not as a point, but as a $3 \times 3 \times 3$ tensor (T_{ijk}) representing knot coordinates in three-dimensional space. This tensor is denoted in a layer format based on the z-axis, where each component represents a position. This tensor illustrates the structure formed by knots in 3D space

$$T_{ijk} = \left\{ \begin{array}{c} \underbrace{\begin{pmatrix} -1x,+1y & 0x,+1y & +1x,+1y \\ -1x,0y & 0x,0y & +1x,0y \\ -1x,-1y & 0x,-1y & +1x,-1y \end{pmatrix}}_{-1z} \\ \underbrace{\begin{pmatrix} -1x,+1y & 0x,+1y & +1x,+1y \\ -1x,0y & 0x,0y & +1x,0y \\ -1x,-1y & 0x,-1y & +1x,-1y \end{pmatrix}}_{0z} \\ \underbrace{\begin{pmatrix} -1x,+1y & 0x,+1y & +1x,+1y \\ -1x,0y & 0x,0y & +1x,0y \\ -1x,-1y & 0x,-1y & +1x,-1y \end{pmatrix}}_{+1z} \end{array} \right\}$$

This tensor-based explanation indicates the spatial positions of knots inside the particle. Knots at specific coordinates are described as 1 (positive twist) or -1 (negative twist), and 0 if there is no knot.

The number of knots included in this tensor is determined by applying the "particle in a box" model. In this model, the energy of a particle trapped in a box is quantized, possessing only integer values **[7]**.

$$E_n = \frac{n^2h^2}{8mL^2} = n^2E_1$$

This formula represents how the energy levels of an electron bound to a nucleus are not continuous but quantized. For a particle to exist stably within a confined space, the number of knots constituting the particle's interior is also proportional to n^2

$$K_n \propto n^2(n = 1,\ 2,\ 3,\ \dots)$$

Based on this "particle in a box" model, we can describe the interior of the tensor.

1. Electron : Since $n = 1$, $n^2 = 1$. This appears as a single condensed point-like form with no spatial structure. Rewriting the electron's case in one dimension:

$$T_e = \left\{ \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{-1z} \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{0z} \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{+1z} \right\}$$

A knot is formed only at the center coordinate $(0,0,0)$, which can be regarded as a point, thus a 1-dimensional particle.

$$T_e = \underbrace{(-1)}_{0z}$$

Electric Charge (Q) is defined as the sum of knots within the tensor divided by the dimension of space. For the electron:

$$Electric\ Charge(Q) = \frac{\sum Knots\ (-1)}{Space\ Dimension(\ 1)} = -1 \tag{3.2.4}$$

2. Up Quark : Since $n = 2$, $n^2 = 4$. Four knots form a structure, possessing a three-dimensional volumetric shape.

$$T_u = \left\{ \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & -1 & 0 \end{pmatrix}}_{-1z} \underbrace{\begin{pmatrix} +1 & 0 & +1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{0z} \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & +1 & 0 \end{pmatrix}}_{+1z} \right\}$$

This shape has a tetrahedral structure with no knot in the center. With one negative twist knot and three positive twist knots, the charge of the Up Quark is:

$$Electric\ Charge(Q) = \frac{\sum Knots\ (+2)}{Space\ Dimension(\ 3)} = +\frac{2}{3} \tag{3.2.5}$$

3. Down Quark : Since $n = 3$, $n^2 = 9$. Nine knots form a structure; it is the heaviest and most stable symmetric structure among the first-generation particles, filling the tensor most fully.

$$T_d = \left\{ \underbrace{\begin{pmatrix} +1 & 0 & +1 \\ 0 & 0 & 0 \\ +1 & 0 & +1 \end{pmatrix}}_{-1z} \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{0z} \underbrace{\begin{pmatrix} -1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & -1 \end{pmatrix}}_{+1z} \right\}$$

It takes the shape of a body-centered cubic, with knots at each vertex of a cube and one in the exact center. With five negative twists and four positive twists, the charge is:

$$Electric\ Charge(Q) = \frac{\sum Knots\ (-1)}{Space\ Dimension(\ 3)} = -\frac{1}{3} \qquad (3.2.6)$$

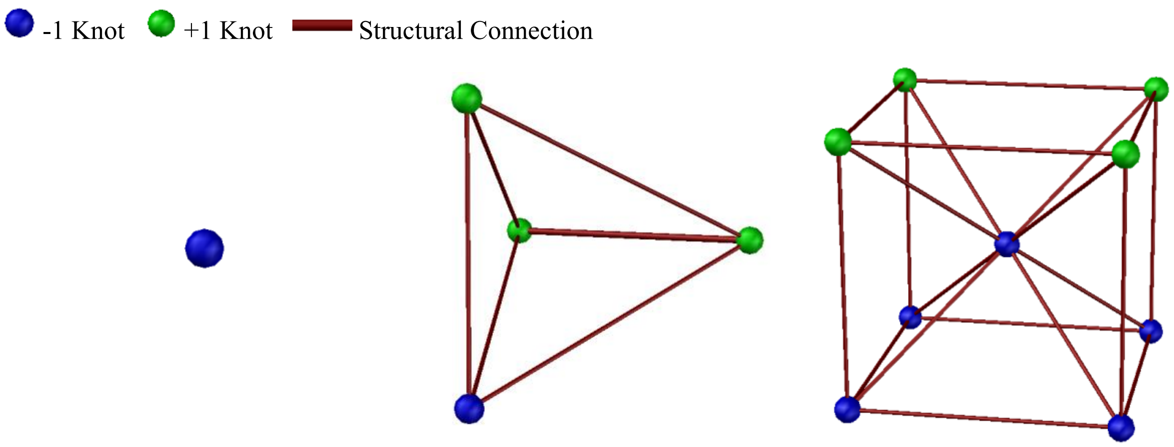
This tensor-based explanation defines electric charge by connecting it with spatial axes. It introduces the concept of "Axial Charge"—meaning a three-dimensional charge quantity based on the x, y, and z axes. This allows for an intuitive explanation of why particles possess fractional charges such as 1/3 or 2/3.

Observing the tensor structure of each particle reveals the persistent presence of a -1 twist within its interior. This -1 twist serves as the connection point with the J-Field and can be interpreted as the origin of the spin-1/2 property. This phenomenon can be explained by the dual structure consisting of the particle's internal configuration and its external connection to the field.

For instance, imagine placing a plate on your palm. If you rotate the plate 360 degrees by passing it under your elbow while keeping the top side facing up, the plate returns to its original position, but the arm connecting it to your body remains twisted. To return the arm to its original untwisted state, the plate must be rotated another 360 degrees, this time passing over the elbow. This imagery of twisting is easily visualized by recalling the arm movements of a rhythmic gymnast performing with a ball or clubs.

In essence, this -1 twist (the central knot in the case of the Down Quark) connects to the J-Field, functioning analogously to the "arm" in the example above.

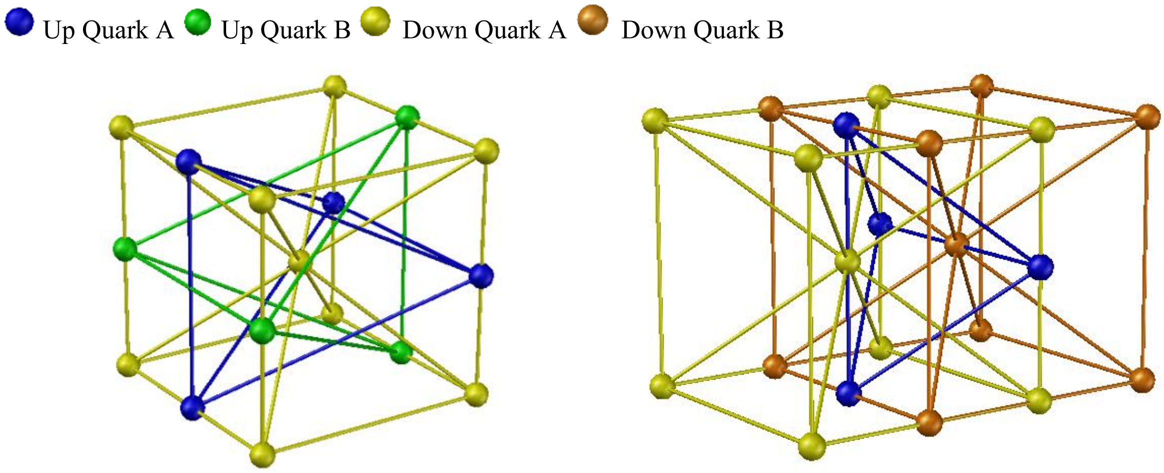
The structure of each particle is illustrated in the figure below:



Electron Up Quark Down Quark

Figure (3.2.1)

The Strong Force can be explained through this structural bonding mechanism.
A Proton consists of two Up Quarks and one Down Quark, while a Neutron consists of one Up Quark and two Down Quarks. Their respective structures can be represented as follows:



Proton Structure   Neutron Structure

Figure (3.2.2)

In the case of the Proton, it can be observed that two Up Quarks form a stable structure centered around the Down Quark. This explains the proton's nature as an extremely stable particle that is resistant to decay.
In the case of the Neutron, the central knot of the Down Quark prevents full bonding; thus, only half of each Down Quark binds, with the Up Quark holding each Down Quark in place to maintain the structure. According to the Pauli Exclusion Principle, knots cannot overlap. Consequently, this results in a structure with two centers, providing an explanation for its unstable state.

Having reconstructed and explained particles in the form of 3-dimensional tensors, we now apply this tensor framework to the particle evolution equation from Section 3.2.1. The equation transforms as follows:

$$\frac{\partial J}{\partial t} = \underbrace{\alpha \nabla^2 J}_{Diffusion\,Term} + \underbrace{\beta F(J)}_{Particle\,Knot\,Term} + \underbrace{\delta A(J)}_{Asymmetry\,Term}$$

$$\downarrow$$

$$\frac{\partial T_{ijk}}{\partial t} = \underbrace{\alpha \nabla^2 T_{ijk}}_{Diffusion\,Term} + \underbrace{F_{ijk}(T)}_{Particle\,Binding\,Term} + \underbrace{I_{ikj}(T,\theta)}_{Electromagnetic\,Term} + \underbrace{S_{ijk}(T)}_{Spin\,Term} \tag{3.2.7}$$

The $\partial T_{ijk}/\partial t$ term on the left-hand side transforms the scalar $\partial J/\partial t$ term from the original equation into a "knots-in-a-box" model possessing a particle structure. In the case of 1st generation particles, they exist stably, so this term converges to 0.

The first term on the right-hand side, $\alpha\nabla^2 T_{ijk}$ corresponds to the $\alpha\nabla^2 J$term in the particle evolution equation and describes energy diffusion.

The second term on the right-hand side, $F_{ijk}(T)$, is similarly represented as the tensor trace of $F(J)$ from the particle evolution equation, signifying the total energy density. First, let us examine the Particle Knot Term of the equation:

$$F(J) = \underbrace{2\mu^2 J}_{Generation\,Term} - \underbrace{4\lambda\,|J|^2\,J}_{Confinement\,Term}$$

$$\downarrow$$

$$F_{ijk}(T) = \underbrace{2\mu^2 T_{ijk}}_{\substack{Stability\ Term \\ (Asymptotic\ Freedom)}} \underbrace{- 4\lambda\left(\sum_{l,m,n} T_{lmn}T_{lmn}\right)T_{ijk}}_{\substack{Structural\ Binding\ Term \\ (Color\ Confinement)}} \quad (3.2.8)$$

$\sum_{l,m,\mathrm{n}} T_{lmn}T_{lmn}$term represents the sum of the squares of all values contained within the tensor components. Each component can only take the values -1, 0, or 1, and the sum is always proportional to n^2
While the scalar field equation explains particle creation, the particle tensor equation explains particle stability and the Strong Force.
The $2\mu^2 T_{ijk}$ term, previously described as the generation term, functions as the Stability Term in the tensor equation. It represents the Asymptotic Freedom of the Strong Force and acts dominantly when the distance between particles is not increasing. The $-4\lambda\ |J|^2\ J$ erm, previously the confinement term, functions as the Structural Binding Term in the tensor equation. As particles separate, the force of $-T^3$ increases rapidly, manifesting as Color Confinement. Furthermore, these two terms cancel each other out, allowing the particle to form a stable structure.

The third and fourth terms on the right-hand side are derived from the Asymmetry Term. By representing the asymmetric particle in tensor form, these terms are differentiated into time and space components and substituted into the tensor. The asymmetry term in the particle evolution equation is expressed as a time derivative involving an imaginary number.

$$A(J) = i\frac{\partial J}{\partial t}$$

In the Lagrangian, the J-Field was expressed as a complex field ($J = \phi e^{-i\omega t}$).
Substituting this allows us to determine the frequency associated with particle creation:

$$i\frac{\partial}{\partial t}(\phi e^{-i\omega t}) = i(-i\omega)J = \omega J$$

This equation represents the natural frequency (ω) of the J-Field. When applied to the tensor, the knot vibrates, thereby inducing vibration in the particle. The energy of a wave is proportional to the square of the frequency (ω^2) , not the frequency (ω) itself. Applying this relationship in tensor form yields:

$$\left(i\frac{\partial}{\partial t}\right)^2 T_{ijk} = \omega^2 T_{ijk}$$

Here, transforming ω^2 into a phase derivative results in the following:

$$\omega^2 = \left(\frac{\partial\theta}{\partial t}\right)^2 \longrightarrow (\partial_\mu\theta)(\partial^\mu\theta)$$

Finally, the vibrational energy varies for each particle. The coupling constant that determines this intensity is the Electric Charge (Q). Since energy is proportional to the square of the charge, the coefficient γ corresponds to Q^2.

$$I_{ijk}(T,\theta) = \gamma(\partial_\mu\theta\partial^\mu\theta)T_{ijk} \quad (3.2.9)$$

This demonstrates the charge of a stationary particle and indicates that the phenomenon of vibration is the underlying factor of electromagnetism.

Now, to derive the final term, the Spin Term, we first separate the spatial component from the Asymmetry Term:

$$A(J) \sim \nabla J$$

The term ∇J represents the spatial gradient of the scalar J-Field energy, indicating that the energy distribution is not flat but biased in a specific direction. This describes the flow of energy from high to low potentials.

Applying the 3-dimensional tensor here enables phenomena such as volumetric structure and rotation. Consequently, the simple differential operator ∇(Gradient) is promoted to the rotational operator ∇ ×(Curl) within the tensor framework.

$$\nabla \times T$$

his is expressed using the Levi-Civita tensor:

$$(\nabla \times T)_{ijk} = \epsilon_{ilm} \partial_l T_{mjk}$$

Applying this to the particle tensor equation completes the Spin Term.

$$S_{ijk}(T) = \eta\left(\epsilon_{ilm} \partial_l T_{mjk}\right) \quad (3.2.10)$$

This term explains the directionality of the Weak Force. The reason why particles in our universe exhibit chirality (left-handedness) will be explained in Chapter 8.

3.2.3 Particle MassIn Sections

3.2.1 and 3.2.2, we investigated the creation, structure, and binding of particles, as well as the three forces and spin. This section aims to elucidate particle mass.

Let us revisit the existing particle tensor equation:

$$\frac{\partial T_{ijk}}{\partial t} = \underbrace{\alpha \nabla^2 T_{ijk}}_{Diffusion\ Term} + \underbrace{F_{ijk}(T)}_{Particle\ Binding\ Term} + \underbrace{I_{ikj}(T,\theta)}_{Electromagnetic\ Term} + \underbrace{S_{ijk}(T)}_{Spin\ Term}$$

Each of these terms represents the magnitude of energy within the particle, which can be expressed as respective mass components according to $E = mc^2$. The fundamental mass is based on the electron, which consists of a single knot. Mass is expressed as a function of the number of knots and the square of the electric charge.

The Diffusion Term represents mass loss caused by energy spreading into space. As the number of knots increases, the structure becomes denser, thereby reducing diffusion. This is described as being inversely proportional to the number of knots (n^2).

The Particle Binding Term is the term that maintains the particle's structure; the more knots there are, the greater the tension required to maintain the particle. This term is proportional to the number of knots (n^2).

The Electromagnetic Term is represented by the total sum of axial charges within the tensor. Since energy is proportional to the square of the charge, it is proportional to Q^2.

The Spin Term, representing a twist caused by external interaction, has a negligible effect on the particle's mass and is therefore omitted in this calculation.

Synthesizing these mass terms completes the equation describing the mass of first-generation particles:

$$m_{p1} = \underbrace{-\frac{A}{n^2}}_{\text{Diffusion Loss}} + \underbrace{B \cdot n^2}_{\text{Structural Tension}} + \underbrace{C \cdot Q^2}_{\text{Electromagnetic Energy}}$$

Based on this, calibrating the coefficients A, B, and C against the actual mass of particles yields the following values:

$$M[MeV] \approx -\frac{0.594516}{n^2} + \left(0.522363 \cdot n^2\right) + \left(0.583153 \cdot Q^2\right) \tag{3.2.11}$$

alculating particle mass using the equation with these calibrated coefficients results in the following comparison:

Particle	Knot No. (n^2)	Charge (Q)	Theoretical Value (MeV)	Observed Value (MeV)
Electron	1	-1	0.510999	0.510999
Up Quark	4	+2/3	2.200002	~ 2.2
Down Quark	9	-1/3	4.700004	~ 4.7

Table (3.2.1)

It is confirmed that each term of the particle tensor equation acts as a component of mass, and the mass values calculated by the equation match the observed values. This demonstrates that particle mass can be calculated based on the particle's structure and electric charge**[8]**.

Thus far, we have calculated the characteristics of particles—from creation to interaction, based on stationary particles—through mathematical derivation rather than simple observation. This demonstrates that, unlike the conventional method of inserting coefficients or constants based on known observed values, we have derived particle creation, structure, and mass starting from the J-Field Lagrangian, passing through the equation of motion.

With this, we have fully explained the "First Axiom: Emergence of Time via Vibration" and the "Second Axiom: Emergence of Matter via Vibrational Energy Condensation."
In the next chapter, we will complete the final J-Field Equation that integrates time, particles, and gravity.

4. Final J-Field Equation

Thus far, from Chapters 2 to 3, we have explored the J-Field, which forms the space of our universe, and the 1st generation particles, which are the fundamental building blocks of all matter we see and feel. Now, we aim to integrate the macroscopic and microscopic worlds into a single equation.

4.1 Final J-Field Lagrangian

In Section 3.2.2, particles were described as geometric, 3-dimensional structures of knots. While this description explains internal properties such as the Strong, Weak, and Electromagnetic forces, a transformation is required to explain the particle's external interaction with the J-Field—namely, Gravity. Although the particle itself is 3-dimensional, its interaction (pressing against the J-Field) occurs on the 2-dimensional surface area of the particle. To express the intensity with which the particle's 2D surface area presses and twists the J-Field, we must perform Dimensional Reduction.

$$T_{ij} = \sum_k T_{ijk}$$

This process can be explained as compressing dimensions, reducing the quantity of 3D knots and electric charge into a 2D plane, as viewed from above.

Taking the Up Quark as an example:

$$T_{u(3d)} = \left\{ \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & -1 & 0 \end{pmatrix}}_{-1z} \underbrace{\begin{pmatrix} +1 & 0 & +1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}}_{0z} \underbrace{\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & +1 & 0 \end{pmatrix}}_{+1z} \right\} \xrightarrow[\text{Dimensional Reduction}]{} T_{u(2d)} = \begin{pmatrix} +1 & 0 & +1 \\ 0 & 0 & 0 \\ 0 & 2 & 0 \end{pmatrix} \quad (4.1.1)$$

In the projection from 3D to 2D, the charges of the -1 and +1 knots cancel each other out, disappearing and leaving only the knots themselves. Consequently, the total number of knots in the particle is maintained at 4, and the particle's charge is preserved at +2/3. This results in the Mass Tensor.

Chapter 2.2 explained the J-Field Lagrangian, and Chapter 3.1 explained the emergence of time via vibration. Chapter 3.2 explained particle creation, structure, forces, and characteristics.

Now that all the actors have gathered, we integrate and explain them as a single tensor.

$$T_{\mu\nu}(J) = \begin{pmatrix} T_{\theta\theta} & T_{\theta x} & T_{\theta y} & T_{\theta z} \\ T_{x\theta} & T_{xx} & T_{xy} & T_{xz} \\ T_{y\theta} & T_{yx} & T_{yy} & T_{yz} \\ T_{z\theta} & T_{zx} & T_{zy} & T_{zz} \end{pmatrix}$$

Simplified, it is written as:

$$T_{\mu\nu}(J) = \begin{pmatrix} T_{\theta\theta} & T_{\theta i} \\ T_{i\theta} & T_{ij} \end{pmatrix} \quad (4.1.2)$$

$T_{\theta\theta}$(0,0 Component) : Phase Vibration Energy Density

1. A physical quantity representing the vibration of a particle or space. It appears as ω^2. The First Axiom $dt = d\theta/\omega$ activates, causing time to flow.
2. In regions of large mass, energy is extremely condensed, causing the $T_{\theta\theta}$ value to become extremely high. The J-Field stretches geometrically due to this mass, resulting in gravitational time dilation.

$T_{\theta i}$, $T_{i\theta}$ ($0, i$ Components) : Phase-Space Interaction

1. Mathematically, this takes the form $\sim \partial T/\partial\theta \cdot \nabla T$. It signifies the propagation of vibration to the spatial axes ($T_{\theta x}, T_{\theta y}, T_{\theta z}$) , representing the phenomenon where the tremor of the J-Field spreads into space—i.e., Light (Electromagnetic Waves).
2. It explains the Electromagnetic Force arising from the direct interaction between the particle and the surrounding space. A larger electric charge (Q) generates stronger light and electric fields.

T_{ij} (i, j Components) : Particle Mass and Structure

1. Diagonal Components (T_{xx}, T_{yy}, T_{zz}) Forces required for the particle to maintain its structure and volume. This force manifests as Mass, acting as the cause of Gravity by pressing against the J-Field.
2. Off-diagonal Components ($T_{xy}, T_{yz}, \ldots$) These describe the twisted knots of the particle, explaining the Strong Force and Spin.

We have thus explained each component of the J-Field Tensor. This tensor posits that vibration generates time, creates light, and serves as the source of particles.

We substitute this dimensionally reduced tensor into the particle tensor equation.

$$\frac{\partial T_{ij}}{\partial t} = \underbrace{\alpha \nabla^2 T_{ij}}_{Diffusion\ Term} + \underbrace{F_{ij}(T)}_{Particle\ Binding\ Term} + \underbrace{I_{ik}(T,\theta)}_{Electromagnetic\ Term} + \underbrace{S_{ij}(T)}_{Spin\ Term} \tag{4.1.3}$$

This tensor explains space, time, matter, and forces all at once.

Based on this tensor, we attempt to redefine the J-Field Lagrangian.
The existing J-Field Lagrangian is as follows:

$$\mathcal{L}_J = \underbrace{\frac{c^4}{16\pi G} R}_{Gravitational\ Term} + \underbrace{\frac{1}{2} g^{\mu\nu}(\partial_\mu J)(\partial_\nu J)}_{Kinetic\ Term} - \underbrace{\left(-\mu^2 |J|^2 + \lambda |J|^4\right)}_{Potential\ Term}$$

This describes the scalar field when the space called the J-Field first begins to vibrate. Since it deals only with the intensity of vibration, it cannot explain the particle's structure or the three forces resulting from particle motion.

Now, we define the Covariant Derivative Operator ($\mathcal{D}$) corresponding to the Diffusion, Electromagnetic, and Spin terms of the final particle tensor equation.

$$\mathcal{D} \equiv \nabla + i\partial_\theta + \epsilon(\nabla \times)$$

∇(Gradient) : Rate of change in space. (Source of Diffusion)
$i\partial_\theta$ (Phase Derivative) : Rate of change in phase (time). (Source of Electromagnetic Force)
$\epsilon(\nabla \times)$ (Curl) : Spatial twist. Combined with the Levi-Civita tensor, it describes rotation. (Source of Spin)

Now, to apply this to the kinetic term of the Lagrangian, the Total Energy (square of the rate of change) is defined.

$$\mathcal{L}_{kinetic} = \alpha \left|\mathcal{D}T_{\mu\nu}\right|^2 = \alpha\left(\mathcal{D}T_{\mu\nu}\right) \cdot \left(\mathcal{D}T_{\mu\nu}\right)^* \tag{4.1.4}$$

Expanding this yields the fundamental energy terms of the particle tensor equation and the interaction terms resulting from their interference.

$$|\mathcal{D}T|^2 = \underbrace{|\nabla T|^2}_{\substack{Spatial\ Gradient \\ Energy}} + \underbrace{(\partial_\theta T)^2}_{\substack{Phase\ Vibration \\ Energy}} + \underbrace{|\nabla \times T|^2}_{\substack{Spatial\ Torsion \\ Energy}} + \underbrace{\cdots\cdots\cdots}_{\substack{Cross-Interaction \\ Terms}} \tag{4.1.5}$$

Let us examine whether the particle tensor equation can be derived from basic dynamics.

The $|\nabla T|^2$ term represents the Spatial Gradient Energy stored as the J-Field deforms. Varying this term yields the Diffusion Term ($\nabla^2 T$) of the particle tensor equation.

The $(\partial_\theta T)^2$ term represents the Phase Vibration Energy. Varying this term yields the Electromagnetic Term ($I(T)$) of the equation, which is proportional to the particle's electric charge (Q).

The $|\nabla \times T|^2$ term represents the Spatial Torsion Energy. Varying this term yields the Spin Term ($S(T)$) of the equation, preserving the particle's intrinsic angular momentum.

The Cross-Interaction Terms derived subsequently appear as cross-terms explaining Electromagnetic-Diffusion, Electromagnetic-Spin, and Diffusion-Spin interactions.

$$\begin{aligned} |\mathcal{D}T|^2 = & \underbrace{\cdots\cdots\cdots}_{basic\ dynamics} + \underbrace{i[(\partial_\theta T)\cdot(\nabla T) - (\nabla T)\cdot(\partial_\theta T)]}_{Electromagnetic-Diffusion\ Term} \\ & + \underbrace{i\epsilon[(\partial_\theta T)\cdot(\nabla \times T) - (\nabla \times T)\cdot(\partial_\theta T)]}_{Electromagnetic-Spin\ Term} + \underbrace{\epsilon[(\nabla T)\cdot(\nabla \times T) + (\nabla \times T)\cdot(\nabla T)]}_{Diffusion-Spin\ Term} \end{aligned} \tag{4.1.6}$$

The Electromagnetic-Diffusion Term describes phenomena arising as a vibrating particle ($\partial_\theta T$) moves through space (∇T). Specifically, it describes an electric current, representing a charged particle's phase propagating through space.

The Electromagnetic-Spin Term describes the spatial torsion ($\partial_\theta T$) arising as a charged particle ($\nabla \times T$) rotates. This generates a Magnetic Moment, serving as the source of magnetic force.

The Diffusion-Spin Term represents the directionality of the particle. It is the sum of the tendency for linear motion (orbital motion - ∇T) and the tendency for rotation ($\nabla \times T$), manifesting as Helicity.

This Integrated Dynamic Lagrangian, resulting from the covariant derivative, explains the particle's structure, energy diffusion due to vibration, charge, and spin. Based on these characteristics, it elucidates current, magnetic moment, and helicity.

Synthesizing these concepts allows for the following explanation:
A particle propagates with spin, exhibiting helicity, effectively taking the form of a vortex. This vortex structure maintains the particle's stability. The helical wave generated by the particle's charge manifests as electric force in its linear component and magnetic force in its rotational component, propagating into the surrounding J-Field. Since the J-Field possesses the properties of a supersolid, this force generated by the particle propagates at the speed of light.

Now, by substituting this covariant derivative operator and tensor-derived from the J-Field Lagrangian in Section 2.2-into the kinetic term of the Lagrangian from Section 2.2, we obtain the Final J-Field Lagrangian.

$$\mathcal{L}_J = \underbrace{\frac{c^4}{16\pi G}R}_{J-Field\ Term} + \underbrace{\alpha\left|\mathcal{D}T_{\mu\nu}(J)\right|^2}_{\substack{Integrated \\ Dynamics\ Term}} - \underbrace{\left(-\mu^2 \left|T_{\mu\nu}(J)\right|^2 + \lambda \left|T_{\mu\nu}(J)\right|^4\right)}_{Potential\ Term} \tag{4.1.7}$$

The J-Field Term describes space not as existing abstract geometry, but as a physical entity. It defines the J-Field as a physical space with supersolid properties, acting as a medium that transmits particle vibration and curvature caused by matter's mass.

The Integrated Dynamics Term explains particle characteristics. It describes the interactions caused by energy transfer to the J-Field and the various forms of energy exchange between the J-Field and the phenomenon of particle vibration.

The Potential Term explains the origin of the J-Field, the genesis of particles, particle mass, and the Strong Force. It is the term that heralds the beginning of our universe.

4.2 Final J-Field Equation

Now, we derive the Final J-Field Equation from the final Lagrangian established in the previous section.

$$\mathcal{L}_J = \underbrace{\frac{c^4}{16\pi G}R}_{J-Field\ Term} + \underbrace{\alpha\left|\mathcal{D}T_{\mu\nu}(J)\right|^2 - F(T_{\mu\nu}(J))}_{Particle\ Term}$$

We derive the final equation of motion by applying the Principle of Least Action to this Lagrangian.

$$S = \int d^4x\sqrt{-g}\left(\frac{c^4}{16\pi G}R + \alpha\left|\mathcal{D}T_{\mu\nu}(J)\right|^2 - F\left(T_{\mu\nu}(J)\right)\right)$$

The action S is determined when it is invariant with respect to variations in the metric tensor $g^{\mu\nu}$ (i.e., $\delta S = 0$)

$$\delta S = \delta S_{J-Field} + \delta S_{Particle} = 0$$

First, we vary the gravitational component with respect to the metric tensor $g^{\mu\nu}$. Applying the variation formulas for the Ricci scalar $R = g^{\mu\nu}R_{\mu\nu}$ and the volume element $\sqrt{-g}$ yields.

$$\begin{aligned}\delta S_{J-Field} &= \tfrac{c^4}{16\pi G}\textstyle\int d^4x\, \delta\left(\sqrt{-g}R\right) \\ &= \frac{c^4}{16\pi G}\int d^4x\, \sqrt{-g}\, \left(R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R\right)\delta g^{\mu\nu}\end{aligned} \tag{4.2.1}$$

Here, the term within the parentheses corresponds precisely to the Einstein Tensor $G_{\mu\nu}$.

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}\, R$$

Next, we vary the matter component ($S_{Particle}$). Following the standard definition in field theory, the rate of change of the matter action with respect to the change in the metric tensor is defined as the Energy-Momentum Tensor:

$$T_{\mu\nu}(J) \equiv -\frac{2}{\sqrt{-g}}\,\delta(\sqrt{-g}\,\frac{\left(\left|\mathcal{D}T_{\mu\nu}(J)\right|^2 - F\left(T_{\mu\nu}(J)\right)\right)}{\delta\, g^{\mu\nu}} \quad (4.2.2)$$

The $T_{\mu\nu}(J)$ derived through this definition becomes a 4×4 Phase-Space Tensor. It encompasses not only the conventional matter tensor but also the vibration of phase ($T_{\theta\theta}$), electromagnetic force ($T_{\theta i}$), and the particle's 3-dimensional knot structure (T_{ij}), representing all stress and energy exerted on spacetime.

Now, by combining the variation results of the left-hand side (J-Field) and the right-hand side (Matter) ($\delta S_{J-Field\ Term} + \delta S_{Particle} = 0$), the following final equation is derived:

$$\frac{c^4}{16\pi G} G_{\mu\nu}(J) = \frac{1}{2} T_{\mu\nu}(J)$$

By rearranging this, we obtain the Final J-Field Equation of Vibrational Cosmology.

$$R_{\mu\nu}\big(g(J)\big) - \frac{1}{2} g_{\mu\nu}(J) R = \frac{8\pi G}{c^4} T_{\mu\nu}(J) \quad (4.2.3)$$

$$T_{\mu\nu}(J) = \begin{pmatrix} T_{\theta\theta} & T_{\theta i} \\ T_{i\theta} & T_{ij} \end{pmatrix}$$

The left-hand side represents the geometry where the J-Field (J-Space) elastically curves in response to the energy of matter. The right-hand side represents the total structural energy exerted as the phase of vibration (time), the propagation of light, and the knots of particles press and twist space. This equation dictates that matter and light ($T_{\mu\nu}(J)$) tell the J-Field how to move energy, while the J-Field ($G_{\mu\nu}$), curved by receiving that energy, tells matter how to vibrate and move through the curved space. This demonstrates that the interaction between the J-Field and particles is not unidirectional but a bidirectional cyclic structure.

Thus, we have successfully derived the Final J-Field Equation of this theory.

5. Interpretation of Fundamental Constants

In Section 2.1, we defined the Planck Elastic Modulus as a characteristic of the J-Field. Here, we attempt to analyze the Gravitational Constant and the Electromagnetic Constant.

To do this, a special physical quantity must be introduced: namely, Mass Pressure.

$$kg/m^2 \tag{5.1}$$

This physical quantity is conceptually distinct from the conventional unit of pressure (N/m^2). It represents the pressure exerted by pure mass occupying space, excluding the component of acceleration (m/s^2).

Decomposing the unit of standard pressure $\left(kg \cdot m/s^2\right)/m^2$ reveals the inclusion of acceleration. However, this quantity cannot explain the phenomenon of a solitary object in space pressing against the J-Field.
If a single object exists in space, it curves the J-Field to create acceleration, but it does not feel acceleration itself. To explain the phenomenon of matter pressing against the J-Field, we must consider that it applies pressure with pure weight, excluding acceleration.

This Mass Pressure is defined as the mass of an object divided by its surface area, interpreted as mass distribution per unit area (kg/m^2).

5.1 Relation between Newton's Gravity Equation and the Gravitational Constant

The Gravitational Constant ($G = 6.674 \times 10^{-11}\ m^3/kg \cdot s^2$) has traditionally been perceived as a fundamental constant to be memorized. However, this theory interprets it differently.

Newton's law of universal gravitation is as follows:

$$F = G\frac{m_1 \times m_2}{r^2}$$

Rearranging this equation allows for the following interpretation:

$$F = G\frac{m_1}{r_1} \times \frac{m_2}{r_2}$$

Here, the meaning of G can be interpreted as follows:

$$\frac{Elastic\ Modulus\ of\ J - Field\ (kg/m \cdot s^2)}{square\ of\ Planck\ Mass\ Pressure\ (kg/m^2)^2} \tag{5.1.1}$$

It signifies the Elastic Modulus of the J-Field reacting to the pressure exerted by two forms of matter solely through their mass.

Elastic Modulus of J-Field (P_p) : $\approx\ 4.633 \times 10^{113}\ kg/m \cdot s^2 P_p \approx\ 4.633 \times 10^{113}\ kg/m \cdot s^2$
Planck Mass Pressure ($P_{m,P}$) : $\approx\ m_P/L_P^2\ \approx\ 8.331\ \times\ 10^{61}\ kg/m^2$

$$G = \frac{P_p}{P_{m,P}^2} \approx \frac{4.633 \times 10^{113}\ kg/m \cdot s^2}{(8.331\ \times\ 10^{61}\ kg/m^2)^2} \approx 0.0667 \times\ 10^{-9}\ m^3/kg \cdot s^2 \approx 6.67 \times\ 10^{-11} m^3/kg \cdot s^2 \tag{5.1.2}$$

This calculation demonstrates consistency with the Gravitational Constant, indicating the necessity of the Mass

Pressure concept.

Interpreting Newton's gravity equation in this light: as two masses (m_1, m_2) press against the J-Field, the curvatures of the J-Field overlap and influence each other. This curved J-Field acts as gravity. As the distance (r_1, r_2) increases, the gravitational curvature created by the two objects pressing the J-Field weakens relative to each object (inversely proportional to $1/r_1 \times 1/r_2$), resulting in an inverse proportionality to the square of the distance (r^2).

5.2 Relation between Einstein's Gravity Equation and the Gravitational Constant

The well-known Einstein Field Equation is as follows:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Here, the meaning of the Gravitational Constant G differs from that in Newton's equation. In this context, G is used to signify the emergence of gravitational acceleration due to the curvature of the J-Field caused by Mass Pressure.

$$\frac{gravitational\ acceleration\ (m/s^2)}{Planck\ Mass\ Pressure\ (kg/m^2)} \tag{5.2.1}$$

It can be interpreted as the gravitational acceleration generated per unit area where a massive object presses against the J-Field.

Planck Acceleration (a_P) $:= L_P/t_P^2 \approx 5.56 \times 10\text{^}51\ m/s^2$
Planck Mass Pressure ($P_{m,P}$) $:= m_P/L_P^2 \approx 8.33 \times 10^{61}\ kg/m^2$

$$G \approx \frac{a_P}{P_{m,P}} = \frac{5.56 \times 10^{51}\ m/s^2}{8.33 \times 10^{61}\ kg/m^2} \approx 0.667 \times 10^{-10}\ m^3/kg \cdot s^2 \approx 6.67 \times 10^{-11} m^3/kg \cdot s^2 \tag{5.2.2}$$

This also yields a value identical to the Gravitational Constant.

Analyzing the constant term $8\pi G/c^4$, we observe that unlike the electromagnetic constant, it is inversely proportional to c^4. This implies that gravity disperses into 4-dimensional spacetime, indicating that it is a significantly weaker interaction compared to the other three forces.

5.3 Relation between Coulomb's Law and Constants

Coulomb's Law is a fundamental principle of electromagnetism describing the magnitude of the electrostatic force. The equation is as follows:

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 \times q_2}{r^2}$$

As is well known, the constant in this equation represents the force ($N \cdot m/C^2$) exerted by the electric charges of two objects over a cross-sectional area. It involves the inverse of vacuum permittivity, ϵ_0. Expressing ϵ_0 in Planck units yields the following:

Planck Force (F_P) : $(m_P \cdot L_P)/t^2 \approx 1.21 \times 10^{44}\ kg \cdot m/s^2$
Planck Area (L_P^2) : $(1.616 \times 10^{-35}\ m)^2 \approx 2.612 \times 10^{-70}\ m^2$

Planck Charge (q_p) : $\approx 1.8755 \times 10^{-18}\ C$

$$\epsilon = \frac{C^2}{4\pi \cdot F_P \cdot L_P^2} \approx \frac{\left(1.8755 \times 10^{-18}\ C\right)^2}{4\pi \cdot \left(1.21 \times\ 10^{44}\ kg \cdot \frac{m}{s^2}\right) \cdot (2.612 \times\ 10^{-70}\ \ m^2)} \approx 8.8542 \times\ 10^{-12}\ C^2/N \cdot m^2$$

Substituting these values to calculate ϵ_0 and then the Coulomb constant (k_e):

$$\frac{1}{4\pi\epsilon_0} = \frac{1}{4\pi \cdot (8.8542 \times\ 10^{-12}\ C^2/N \cdot m^2)} \approx 8.987 \times\ 10^9\ N \cdot m^2/C^2 \qquad (5.3.1)$$

Theoretical Calculation : $k_e \approx\ 8.987 \times\ 10^9\ N \cdot m^2/C^2$
Actual Observed Value : $k_e \approx\ 8.98755 \times\ 10^9\ N \cdot m^2/C^2$

Comparing the theoretical and actual observed values reveals a near-identical match.

Observing the constant here, the coefficient c^4 is absent. Unlike gravity, this implies that the force does not disperse into spacetime but represents a direct particle-to-particle interaction.

The constant of this equation can be written as:

$$k_e = \frac{F_P \cdot L_P^2}{C^2} \approx \frac{(1.21 \times\ 10^{44}\ N) \cdot (2.612 \times\ 10^{-70}\ \ m^2)}{\left(1.8755 \times 10^{-18}\ C\right)^2} \approx 0.89878 \times\ 10^{10} \approx 8.9878 \times\ 10^9\ N \cdot m^2/C^2 \qquad (5.3.2)$$

It is possible to derive the value of k_e simply using Planck unit values.

5.4 Relation between Ampere's Force Law and Constants

Ampere's Force Law is another fundamental equation of electromagnetism. It describes the magnetic field between two current-carrying wires and takes the form:

$$\frac{F}{L} = \frac{\mu_0}{2\pi} \frac{I_1\, I_2}{r}$$

The unit of vacuum permeability μ_0 is N/A^2. Breaking this down into Planck units yields:

Planck Current (I_P) : $\frac{q_P}{t_P} \approx\ 3.48 \times\ 10^{25}\ A$

$$\mu_0 \approx \frac{4\pi \cdot (1.21 \times\ 10^{44}\ N)}{(3.48 \times\ 10^{25}\ A)^2} \approx 1.2567 \times 10^{-6}\ N/A^2 \qquad (5.4.1)$$

Theoretical Calculation : $\mu_0 \approx 1.2567 \times 10^{-6}\ N/A^2$
Actual Observed Value : $\mu_0 \approx 1.256637 \times 10^{-6}\ N/A^2$

Like permittivity, vacuum permeability shows no dispersion due to c^4. This also signifies a direct particle-to-particle interaction.

This constant can also be described using Planck units.

$$\frac{\mu_0}{2\pi} = \frac{F_P}{I_P^2} \times 2 \approx \frac{(1.21 \times\ 10^{44}\ N)}{(3.48 \times\ 10^{25}\ A)^2} \times 2 \approx 2 \times 10^{-7}\ N/A^2 \quad (5.4.2)$$

The value of this constant can be derived from Planck units. The factor of 2 can be seen as representing two current flows, as the interaction arises not from a single particle or single current, but from the interaction between two currents.

Thus far, we have explained the meanings of constants in the most fundamental equations of modern physics and their derivation processes from Planck units. Of course, conceptually, these constants could be viewed as a circular structure. However, just as we determined the Planck constants based on the characteristics of the J-Field, we have reinterpreted these constants as originating from the physical reality of the J-Field.

This interpretation views these constants as phenomena manifesting due to the inherent properties of the medium known as the J-Field.

6. Relativity Viewed through Vibration

Albert Einstein's Theory of Relativity is a monumental theory that forms the foundation of 20th-century physics. Special Relativity, based on the axiom of the constancy of the speed of light, and General Relativity, based on the Equivalence Principle, revolutionized our understanding of time, space, and gravity.
However, I aim to redefine these concepts from the perspective of Vibrational Cosmology. While Einstein's perspective was the "constancy of light speed," the perspective of Vibrational Cosmology is "Vibration." I intend to explain the Theory of Relativity through the intrinsic vibration of particles. This presents a perspective distinct from the conventional view.

6.1 Time Dilation – Phase Change of Vibration

Every particle possesses its own intrinsic frequency. The phase change of this vibration creates the phenomenon of Time Dilation. This implies not merely an apparent slowing of time, but a real deceleration of the actual speed of time.
In Section 3.1, time was described as follows:

$$dt = \frac{d\theta}{\omega}$$

The meaning of this equation is that the rate of time flow changes according to the rate of phase change. In other words, the change in phase caused by velocity alters the relative speed of time flow.

The vibration of a stationary mover appears to the observer to be identical to their own. This indicates the same flow of time. However, when the mover begins to move with velocity, the observer perceives a time dilation resulting from the shift in the mover's phase angle. This situation, viewed from the perspectives of the observer and the mover, can be represented as follows:

$$\frac{dt}{dt_0} = sin(\theta)$$

When $\theta = 90°$, $sin(\theta) = 1$. At this point, the velocity is 0, and the time flow of the mover and the observer is identical. As the mover acquires velocity and begins to move, a phase change occurs. The time of the mover as seen by the observer is:

$$dt = sin(\theta) \cdot dt_0 \tag{6.1.1}$$

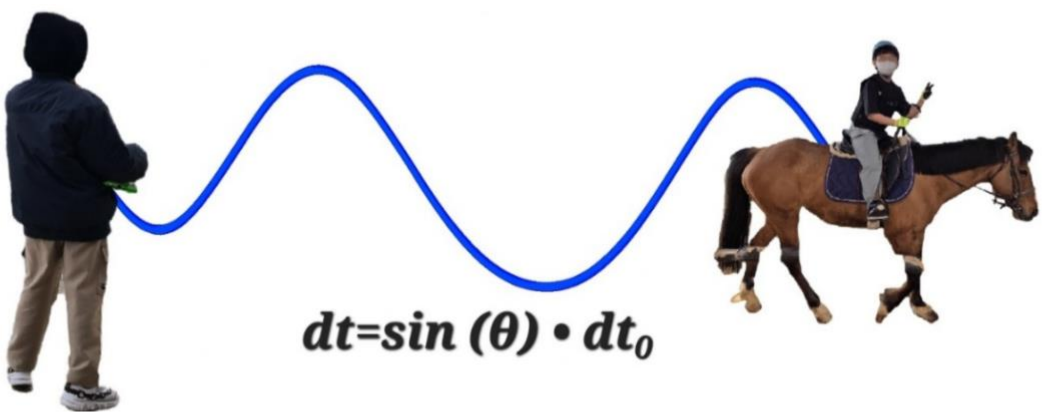


Figure (6.1.1)

The change in phase angle due to velocity is based on the speed of light. At the speed of light, time becomes 0. Based on this, the change in phase angle due to the mover's velocity can be expressed as:

$$\frac{v}{c} = cos(\theta) \quad \longrightarrow \quad v = cos(\theta) \cdot c \tag{6.1.2}$$

The movement speed is gauged by "how much the phase changes relative to the speed of light, where time flow becomes zero." The phase change caused by this velocity manifests as time dilation.

The relationship between this velocity and time can be expressed using basic trigonometric functions:

$$sin(\theta)^2 + cos(\theta)^2 = 1$$

$$\left(\frac{dt}{dt_0}\right)^2 + \left(\frac{v}{c}\right)^2 = 1$$

$$\frac{dt^2}{dt_0^2} = 1 - \frac{v^2}{c^2} \quad \longrightarrow \quad \frac{dt}{dt_0} = \sqrt{1 - \frac{v^2}{c^2}}$$

$$dt = \sqrt{1 - \frac{v^2}{c^2}} \cdot dt_0$$

This signifies how much slower the mover's time flow (dt) is compared to the observer's time flow (dt_0).

$$dt_0 = \frac{dt}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{6.1.3}$$

Here, dt_0 is based on the observer's time flow being 1 (at rest).
This demonstrates the derivation of the Lorentz factor.

$$dt_0 = \gamma\, dt$$

Thus, time dilation can be explained by the phase change of vibration due to velocity.

The perspectives of dt_0 and dt here differ from conventional relativity.
Conventional relativity describes events from the mover's perspective, whereas here, they are described from the observer's perspective. dt_0 is the time flow of the object at rest (the observer's time)**[9]**, and dt represents the mover's time flow as seen by the observer.

Here remains the question: "Why does the mover see the observer's time dilation?"
This depends on the direction of the mover. When the mover recedes from the observer, the observer appears to the mover to have slower time. This is because, as the mover moves away due to their velocity, the time it takes for light to reach the mover becomes longer than when at rest.
Conversely, when the mover approaches the observer, the observer appears to have faster flowing time. As the mover approaches, the time it takes for light departing from the observer to reach the mover becomes shorter.
This phenomenon corresponds to the "Loaf of Bread" analogy often discussed in Special Relativity.

Here, we need to re-examine the time dilation formula.

$$dt_0 = \frac{dt}{\sqrt{1 - \frac{v^2}{c^2}}}$$

If we take the inverse of this formula, it becomes the unit of frequency.

$$\frac{1}{dt_0} = \frac{\sqrt{1 - \frac{v^2}{c^2}}}{dt}$$

$$f_0 = f \cdot \sqrt{1 - \frac{v^2}{c^2}} \quad (6.1.4)$$

This demonstrates that the phenomenon of time dilation is a manifestation of frequency change. It indicates that a change in frequency—specifically, a frequency shift caused by the object's phase change—can exhibit the time dilation effect.

When a mover reaches the speed of light, this implies that time becomes 0. Time becoming 0 means that distance loses its meaning, implying that the mover arrives simultaneously with its departure ($0s/m$).This phenomenon applies to both the mover and the observer, signifying that the moment the mover reaches the speed of light, it effectively undergoes teleportation.

6.2 Length Contraction and Mass Increase

When the effect of time dilation occurs, length contraction and mass increase inevitably follow.
I will interpret these phenomena not through Einstein's conventional view, but from the perspective of Vibrational Cosmology.

6.2.1 Length Contraction – An Illusion Caused by Time Dilation

This theory interprets the concept of velocity-induced length contraction differently.
Distance does not physically contract due to velocity. It is an illusion arising because the denominator (time) in the physical quantity of velocity (m/s), typically perceived as an absolute value, changes.
In other words, it means that the 's' in m/s has changed, not the 'm'.

The formula for length contraction is as follows**[9]**:

$$L = \frac{L_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Replacing the Lorentz factor here with the vibrational angle formula yields:

$$L = L_0 \cdot sin\theta \quad (6.2.1)$$

This is akin to saying, "I ran at 10 m/s, but I covered 20 meters in just 1 second."

This needs to be re-examined from the perspective of time.
The form of simultaneous equations can be viewed as follows:

$$v = c \cdot cos\theta \qquad\qquad dt = dt_0 \cdot sin\theta$$

The reference point for the time taken to travel 10 meters changes due to velocity.
Although proceeding at $v = 10m/s$, since 's' has changed due to velocity, the speed felt by the mover becomes $10m/0.5s$, making it feel like $20m/s$. Interpreting this as "I ran at $10m/s$... so the distance must have shrunk!" is logically flawed.

To summarize, the comparison is as follows:
Conventional Exp. : Moved $10m$ → Distance contracted due to velocity, covered 20m in 1s. ($20m/1s$)
Vibrational Cosmology Exp. : Moved $10m$ → Time dilated due to velocity, covered 10m in 0.5s. ($10m/0.5s$)

Of course, the mathematical results are identical. However, a fundamental difference in interpretation arises. This difference transforms the abstract phenomenon of length contraction into an intuitively explainable one.

Existing: "Time dilation caused distance contraction."
Revised: "Time dilation allowed arriving at the same distance in a shorter timeframe."

It should be viewed as an illusion resulting from calculating the time unit of m/s as a fixed absolute value of 1 second. If time has dilated, shouldn't it be calculated as $m/0.5s$?
The conventional view appears to be an interpretation error caused by using a changing time as a fixed reference point while simultaneously trying to explain time dilation.

Even using the formula $L = L_0 \cdot sin\theta$, the result remains the same. Only the interpretation differs.

6.2.2 Mass Increase – Increase in Mass Pressure

Previously, we demonstrated that time dilation, explained through vibration, derives the Lorentz factor. Applying the same conclusion to Special Relativity allows us to explain mass increase via the vibration angle. First, the relativistic mass formula is as follows**[9]**:

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Replacing the Lorentz factor here with the vibration angle formula yields:

$$m = \frac{m_0}{sin\theta} \tag{6.2.2}$$

As time dilates, mass increases. This implies that velocity increases the depth to which the particle presses against the J-Field, and this increased depth manifests in the form of mass.

In standard theory, if a massive particle reaches the speed of light, its mass becomes infinite.
This implies an impossibility.

In this theory, the meaning of mass increase is defined by how much the particle presses the J-Field, the resulting depth of displacement, and the consequent gravitational acceleration. Essentially, mass signifies: "How much displacement does the object maintain while overcoming the elastic force of the J-Field?"

However, in this theory, before a particle reaches the speed of light, it becomes unable to withstand its own energy density. Consequently, the knot unravels, releasing its energy and returning to space (the J-Field).

Let us revisit the Final Lagrangian:

$$\mathcal{L}_J = \underbrace{\frac{c^4}{16\pi G} R}_{J-Field\ Term} + \underbrace{\alpha \left| \mathcal{D} T_{\mu\nu}(J) \right|^2 - F(T_{\mu\nu}(J))}_{Particle\ Term}$$

Due to the two terms describing the particle here, this implies that the particle cannot withstand the mass increase caused by velocity; the knot unravels, and the particle is annihilated.

While the energy of the Integrated Dynamics Term ($\left|\mathcal{D}T_{\mu\nu}(J)\right|^2$) in the particle term can grow infinitely, there is a limit to the energy the Particle Generation Term ($F(T_{\mu\nu}(J))$) can withstand. As velocity increases, the external force applied to the particle eventually exceeds the internal force maintaining its structure, making it impossible for the particle to preserve its existence.

6.3 The Principle of Invariance of the Speed of Light

"Why is the speed of light I measure always the same, whether I run towards the light or away from it?"
This is the most fundamental question of Special Relativity. While Einstein adopted this as an axiom to be accepted without proof**[9]**, this theory presents a concrete physical mechanism for the underlying reason.
The answer lies in the perfect harmony between the phenomenon of time dilation occurring in the moving observer (mover) and the resulting phenomenon of apparent length contraction.

The mover's clock actually slows down ($dt = \gamma dt_0$), and the distance appears to shorten ($L = L_0/\gamma$). These two changes precisely cancel each other out so that you remain completely unaware of your absolute motion, ensuring that the speed of light you measure always results in the same value (c).

The speed of light (c) measured by the mover is calculated as: (Distance measured by mover) / (Time measured by mover). Measurement of Distance: Since the mover perceives that the unit of distance (their ruler) has actually shortened by a factor of $1/\gamma$, the external real distance L_0 is measured by the mover as being γ times longer.

$$\gamma \cdot L_0$$

Measurement of Time: Since the mover's clock actually ticks γ times slower, the external real time t_0 is measured by the mover as being γ times longer.

$$\gamma \cdot t_0$$

Substituting this into the velocity calculation formula yields:

$$c = \frac{\gamma \cdot L_0}{\gamma \cdot t_0}$$

The γ factors included in both measurements cancel out exactly.

$$c = \frac{L_0}{t_0} = c_0 \tag{6.3.1}$$

Consequently, the speed of light (c) measured by the mover is always identical to the actual speed of light (c_0). In this theory, the invariance of the speed of light is not a mysterious axiom, but an inevitable consequence generated by the actual physical changes occurring in the observer possessing velocity.

6.4 The Principle of Inertia – Another Face of the J-Field

Inertia, one of the most fundamental concepts in physics, refers to the tendency of an object to maintain its state of motion.

Inertia is the resistance to the deformation of the J-Field.

When an object with mass moves, the J-Field reacts to that movement at the speed of light, yielding space. This can be explained by the supersolid property: it is structurally ordered yet capable of fluid-like movement. Inertia is the J-Field's resistance to the change in the angle of curvature as it moves out of the way. In the case of constant velocity, the angle at which the J-Field yields and the angle at which it rejoins after the object passes remain constant.

However, a change in velocity due to acceleration alters the yielding angle of the J-Field. This change in angle generates a resistance force, which manifests as inertia. The force ($F = ma$) we apply to accelerate an object is essentially the force required to overcome this resistance.

Objects with larger intrinsic mass cause greater deformation in the surrounding J-Field; thus, the resistance required to change that state—i.e., inertia—is also greater. This is the origin of inertial mass.

The external force applied to accelerate an object is used to overcome the resistance pressure exerted by the J-Field as it resists change. This force is equal to the resistance pressure multiplied by the interaction area (surface area of matter).

$$F_{applied} = P_{reaction}(J) \cdot A$$

This is defined as the Pressure Resistance Coefficient (η_J) multiplied by acceleration.

$$P_{obj} = \eta_J \cdot a$$

η_J : Pressure Resistance Coefficient of the J-Field

According to the Law of Action-Reaction, the resistance pressure ($P_{reaction}(J)$) exerted by the J-Field is equal in magnitude to the pressure exerted by the object (P_{obj}).

$$P_{reaction}(J) \ = \ P_{obj}$$

Now, substituting these relationships into the first formula:

$$F_{applied} = P_{obj} \cdot A = (\eta_J \cdot a) \cdot A$$

Rearranging this equation yields:

$$F_{applied} = (\eta_J \cdot A) \cdot a$$

This final formula demonstrates that force (F) is directly proportional to acceleration (a). The proportionality constant corresponds to ($\eta_J \cdot A$).

Now, Inertial Mass (m) is no longer a fundamental quantity but a derived value defined as follows:

Inertial Mass (m) = Pressure Response Coefficient of J-Field (η_J) × Interaction Area of Object (A)

The characteristics of the J-Field were defined in Planck units. Deriving the Pressure Response Coefficient (η_J) from Planck units leads us to a familiar value.

$$P_{obj} = \eta_J \cdot a$$

$$\eta_J = \frac{P_{obj}}{a} \quad (6.4.1)$$

By substituting the Planck Pressure ($P_{m,P}$) and the maximum acceleration, Planck Acceleration (a_P), into this equation:

Planck Pressure ($P_{m,P}$) : $\approx 8.33 \times 10\text{^}61\ kg/m^2$
Planck Acceleration (a_P) : $\approx 5.56 \times\ 10\text{^}51\ m/s^2$

$$\eta_J = \frac{P_{m,P}}{a_P} \approx \frac{8.33 \times 10\text{^}61\ kg/m^2}{5.56 \times 10^{51}\ m/s^2}$$

$$\eta_J \approx 1.50 \times 10^{10} kg \cdot s^2\ /\ m^3 \quad (6.4.2)$$

This Pressure Response Coefficient equals the inverse of a familiar value.

$$\frac{1}{G} = \frac{1}{6.674 \times\ 10^{-11}\ m^3/kg^1\ s\text{^}2} \approx 0.150 \times 10^{11} \approx 1.50 \times 10^{10}\ kg \cdot s^2/m^3$$

$$\eta_J = \frac{1}{G} = G^{-1} \quad (6.4.3)$$

It is precisely the inverse of the Gravitational Constant ($1/G$).The Pressure Response Coefficient (η_J), representing the J-Field's resistance to acceleration, is in an exact inverse relationship with the strength of gravity (G). This value proves that Inertia and Gravity are fundamentally different expressions of the same phenomenon. In other words, the J-Field reveals its nature as Inertia in dynamic conditions (acceleration) and as Gravity in static conditions (mass).

When an object reaches the speed of light, the angle of deformation in the J-Field becomes 90°, creating a wall-like barrier that makes further acceleration impossible. This phenomenon explains why exceeding the speed of light is impossible.

6.5 General Relativity Viewed through Vibrational Cosmology

Einstein's General Relativity explains gravity via the geometry of curved spacetime, taking the Equivalence Principle as its core starting point**[5]**.

Vibrational Cosmology takes this a step further. It posits that spacetime is a physical entity called the J-Field, and explains that gravity is a phenomenon resulting from the actual deformation of this J-Field.
The phenomenon of gravity is the curvature of spacetime, i.e., the J-Field. This response, curving toward the center of mass due to the object's mass, creates potential energy. This generates the gravitational acceleration felt by other matter.

Reinterpreting the Equivalence Principle reveals that the reason inertia and gravity are indistinguishable is that both phenomena stem from the same root: interaction with the J-Field. We can define them as follows:

Acceleration: The phenomenon where an object receives force against the dynamic resistance of the J-Field.
Gravity: The situation where an object receives potential energy due to the static deformation of the J-Field

The curvature of spacetime is no longer an abstract concept. It is a physical deformation created by the mass of matter actually applying pressure to the J-Field.

These phenomena can be explained by the J-Field Equation.

$$R_{\mu\nu}\big(g(J)\big) - \frac{1}{2} g_{\mu\nu}(J) R = \frac{8\pi G}{c^4} T_{\mu\nu}(J)$$

This equation represents the interaction between the particle (created by the field itself) and the J-Field (the self). Self-curvature is the result of self-energy condensation.

In this chapter, we have confirmed how the phenomena presented by Einstein's Theory of Relativity can be reinterpreted from the perspective of Vibrational Cosmology.
Instead of accepting the invariance of light speed or the Equivalence Principle as axioms, this theory explains all relativistic effects through a fundamental cause: the interaction between a single physical medium—the J-Field—and the knots (particles) moving within it.

7. Quantum Mechanics Viewed through Vibration

In conventional Quantum Mechanics, time is described as a fundamental dimension. However, in this theory, time is not a fundamental dimension but is explained as the process of perceiving the phase change of vibration. This perspective aims to explain phenomena that conventional theories, which view time merely as a dimension, fail to address.

7.1 Vacuum Energy – Fundamental Vibration of the J-Field

From a classical perspective, a vacuum is a state of absolute 'nothingness' containing nothing.
However, in this theory, a vacuum is not empty space but signifies the lowest energy state of the J-Field, the fundamental entity of the universe. According to Heisenberg's Energy-Time Uncertainty Principle in quantum mechanics, a state of perfect rest—where energy is exactly zero—cannot exist in the universe**[10]**.
This corresponds to the minimum vibration generated by the medium known as the J-Field.

In Section 2.1 of this theory, it was explained that the J-Field vibrates in Planck units. Vacuum Energy is precisely this fundamental minimum vibration of the J-Field, and this is the true identity of Zero Point Energy. The vacuum is not a quiet state but resembles a dynamic ocean that is perpetually vibrating at the most fundamental level.

The Energy-Time Uncertainty Principle is expressed by the following equation:

$$\Delta E \cdot \Delta t \geq \frac{\hbar}{2}$$

From the perspective of this theory, each term is reinterpreted as follows:
ΔE : The energy contained in a single fluctuation that the vacuum (J-Field) can generate during Planck time (t_P).
Δt : The time interval (Planck Time) during which the J-Field's most fundamental 'single fluctuation' persists.
$\hbar$: The Dirac Constant.

These ceaseless vibrations fill every space in the universe, and the sum total of these vibrations constitutes Vacuum Energy.

7.2 Uncertainty Principle - Fundamental Vibration of Particles

Heisenberg's Uncertainty Principle states that the position and momentum (velocity) of a particle cannot be simultaneously determined with precision. In this theory, this principle is not attributed to the limitations of measurement or the probabilistic nature of the world, but is an inevitable consequence of the vibration generated by the particle. A particle is not a dot stamped in empty space; it is a vibrating particle created by the vibrating medium, the J-Field. Within this single entity of a "vibrating particle," two types of information are contained in a mutually conflicting manner.

In Section 3.2.2, the electron was described as a particle with a 3-dimensional structure. The center of this particle represents its position information.
To see this center clearly, one must capture the particle's movement instantaneously. If one captures a very brief moment to see the center, the overall vibration pattern of the particle during that moment becomes completely invisible. Consequently, momentum information is entirely lost.
Momentum information corresponds to the vibrating pattern of the knot itself. To see this vibration pattern clearly, one must observe how the particle moves over several cycles for a longer duration.

These two requirements are fundamentally impossible to satisfy simultaneously with precision. If one observes over a long period to see the knot's vibration pattern, the center of the knot moves and vibrates during that time, making it impossible to specify its exact position.

Consider taking a photograph of stars.
If the camera's exposure is set to be short, the star's current position is captured clearly. However, the trajectory the star traces across the sky cannot be confirmed.
Conversely, if the photo is taken with a long exposure, the star's entire trajectory is visible, but its exact position at any single moment becomes unidentifiable.

In conclusion, the Uncertainty Principle is not a limitation of measurement technology. It is a fundamental limitation arising because the two pieces of information—position and momentum—are contained within a single entity, the vibrating knot, in a conflicting manner.
This relationship is expressed by Heisenberg's Uncertainty Principle formula**[10]**:

$$\Delta x \cdot \Delta p \geq \frac{\hbar}{2}$$

Δx : Uncertainty of position (The degree of indistinctness of the particle's center)
Δp : Uncertainty of momentum (The degree of indistinctness of the vibration pattern)
$\hbar$: Dirac Constant

This formula mathematically demonstrates that the more precisely the position is known (as Δx decreases), the more uncertain the momentum must become (as Δp increases), and vice versa. This is the inevitable result of the vibrating knot model.

7.3 Particle-Wave Duality – Waves of the J-Field Generated by Particles

Every particle is accompanied by both particle-like and wave-like properties. While this concept shares its essence with the De Broglie-Bohm matter wave theory, here we explain it based on "Vibration," which we consider the fundamental essence of the universe**[11]**.

The J-Field has been defined as a frictionless supersolid that vibrates ceaselessly in Planck units. The frictionless J-Field reacts to a particle's vibration at the speed of light, becoming synchronized with the particle's vibration. This implies that the particle and the wave are not in a cause-and-effect relationship, but are rather the particle aspect and the wave aspect of a single event. They exist together—so perfectly simultaneous that the difference is unmeasurable—and propagate together at the speed of light.

However, due to the Principle of Relativity, the speed of the wave generated by light manifests as the speed of light. From the experiential perspective of light (where time is zero), this wave of the J-Field effectively reaches the screen before the light itself. The light then proceeds along the pattern of this wave according to the Principle of Least Action.

The J-Field's nearly instantaneous reaction to the particle's vibration is explained based on De Broglie's matter waves. According to De Broglie's theory, a particle with a specific momentum (p) and energy (E) can be described as a plane wave with a corresponding wavelength ($\lambda = h/p$) and angular frequency ($\omega = E/\hbar$).

$$\Psi(x,t) = A\, e^{i(kx-\omega t)}$$

$k = 2\pi/\lambda$: Wave number (inverse of wavelength)
$\omega = 2\pi f$: Angular frequency (speed of vibration)

The subsequent concepts are explained via the interference described by the wave equation.

$$\Psi_{total} = \Psi_1 + \Psi_2$$

Two waves reaching a specific point (x) on the screen acquire a phase difference due to the difference in distances (r_1, r_2) from each slit.

$$\Psi_1 = Ae^{i(kr_1 - \omega t)} \qquad \Psi_2 = Ae^{i(kr_2 - \omega t)}$$

The Total Wave Function is expressed as follows:

$$\Psi_{total} = A(e^{ikr_1} + e^{ikr_2})e^{-i\omega t}$$

The probabilistic position of the particle resulting from the wave can be explained using the Principle of Least Action and Path Integrals.

$$K(B,A) = \int \mathcal{D}[x(t)]e^{\frac{iS[x(t)]}{\hbar}}$$

$S[x(t)\ ]$: Action for each individual path.
$e^{iS[x(t)]/\hbar}$: Phase of each path.

This signifies that matter is not described as being both a particle and a wave itself; rather, it is a particle accompanied by a wave of the J-Field generated by that particle. While the observed effect is identical, this represents a fundamental shift in perspective.

Here, it is necessary to examine what "observation" truly implies.
The act of observation is the act of colliding light with a particle. This collision forces the regeneration of the wave that the particle induces in the J-Field, forming a new wave and severing the connection with the existing (previous) wave.
This process can be represented as follows:

$$\underbrace{\Psi(x,t) = Ae^{i(kx-\omega t)}}_{Initial\ Wave\ generated\ by\ the\ Particle} \rightarrow \underbrace{\Psi_{total} = A(e^{ikr_1} + e^{ikr_2})e^{-i\omega t}}_{Total\ Wave\ after\ passing\ through\ Slits} \rightarrow \underbrace{\Psi'(x',t) = A'e^{i(k'x'-\omega' t')}}_{Regenerated\ Wave\ after\ "Observation"} \tag{7.3.1}$$

The act of observation signifies interaction with other particles. Interaction with light is a prerequisite for the act of observation. In the microscopic world, the act of observation inevitably translates to a physical collision between particles.

7.4 Zero Seconds via Vibration Cancellation – Another Mechanism for 0 Seconds via Phase Change

Conventional theories establish time as a fundamental dimension, and thus do not introduce the concept that time can stop. This makes it difficult to explain phenomena such as Quantum Entanglement, Quantum Leaps, and Quantum Tunneling. However, if we view time not as a dimension but as a result of vibration, the concept of "0 Seconds" can be introduced, making the explanation of these phenomena possible.

In Section 3.1 of this theory, time was explained as follows:

$$dt = \frac{d\theta}{\omega}$$

As seen in this formula, time represents the flow driven by phase change.
"Time stopping" implies that there is no change in phase. This does not mean the particle's intrinsic vibration ceases; rather, it demonstrates that the particle's vibration can be cancelled out by external vibrations (destructive interference), causing time to temporarily become 0 seconds.

$$sin(\theta) + sin(\theta + \pi) = 0 \tag{7.4.1}$$

When time stops, spatial distance also loses its meaning due to the inverse of velocity (s/m). This state precisely generates various quantum phenomena such as Quantum Entanglement, Quantum Leaps, and Quantum Tunneling.

This principle is a phenomenon caused by relational vibration cancellation. In reality, only the phenomenon of cancellation manifests; the vibration information of each particle does not disappear. According to the "Second Axiom: Vibration determines the characteristics of matter," the intrinsic vibration, which defines the individuality of each particle, cannot vanish. It merely appears as a cancellation phenomenon. According to the "First Axiom: Change in vibration creates time," if vibration is apparently cancelled and appears to be zero, we arrive at the same conclusion: Time ceases to flow.

7.4.1 Quantum Entanglement via Vibration Cancellation

When a single parent particle with a total spin (rotation) of 0 decays and splits into two new particles, A and B, the Law of Conservation of Angular Momentum dictates that if Particle A is in an Up-Spin (+) state, Particle B must naturally be in a Down-Spin (-) state. Of course, consistent with conventional theory, it is impossible to know which is Up or Down prior to observation.

This state can be interpreted as a Relational Vibration Cancellation (Destructive Interference) between Particle A and Particle B. In the state of these two entangled particles, the phases of their spin information cancel each other out, preserving them in a "0-Second State." Since time does not flow, the spin information remains indeterminate (unknown). This implies that the state at the moment of the parent particle's decay is being preserved exactly as it was.
However, the act of observation disrupts this relational vibration cancellation, causing time to resume flowing. Once time begins to flow, the state of the particles is immediately determined, fixing them into Up-Spin and Down-Spin states.

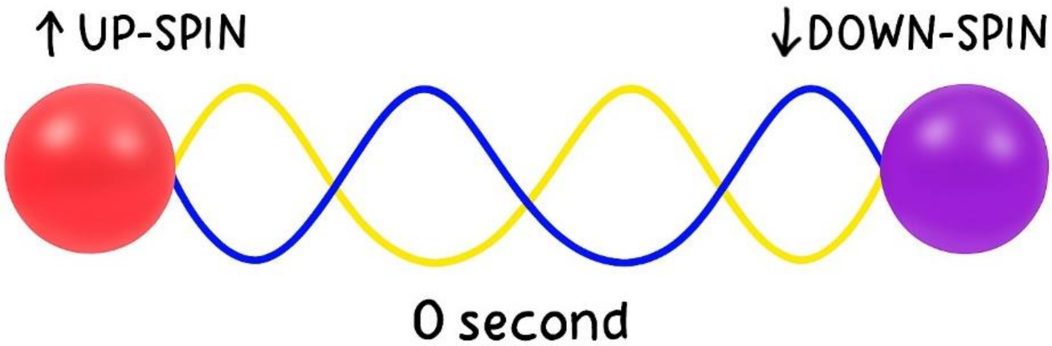


Figure (7.4.1)

This signifies that the pre-existing state of the parent particle already contained both Up-Spin and Down-Spin information, and this information was inherent in the parent particle's state.
The act of observation interferes with the phase of vibration. This breaks the condition for vibration cancellation, causing vibration to manifest and time to flow. With the emergence of time flow, the two particles resulting from the decay confirm their respective spin states.
This implies that only a specific part of the particle's vibration is cancelled—specifically, only the vibration carrying the particle's information (spin state) undergoes cancellation.

The explanation for the violation of Bell's Inequality in quantum entanglement can be described through the mechanism of particle alignment and re-alignment.
Two entangled particles exist in a 0-Second State where the time flow for both particles has ceased due to the perfect cancellation of their information ($\omega = 0$). The essence of this state is that while the individual states of the particles are undetermined, the sum of their measurement values is always zero.

The vector of the two particles in this entangled state corresponding to this concept is as follows**[12]**:

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|\uparrow\rangle_1|\downarrow\rangle_2 - |\downarrow\rangle_1|\uparrow\rangle_2)$$

Now, the moment Particle A is measured, the cancellation of the 0-Second State is broken, and time begins to flow. Consequently, the state of the entire system aligns (collapses) into a single outcome.
Assume we measure Particle A along the z-axis (0°) and obtain Up ($|\uparrow\rangle_1$). At this instant, the total state vector $|\psi\rangle$ aligns (collapses) to the term $|\uparrow\rangle_1|\downarrow\rangle_2$, which corresponds to this result.
Consequently, Particle B is confirmed to be in the Down state ($|\downarrow\rangle_2$) relative to the z-axis (0°).

When measuring Particle B (which is already aligned to Down) along a direction forming an angle θ with the z-axis, the measurement stimulates Particle B, causing it to re-align in the direction of angle θ. The result of this re-alignment is determined probabilistically according to the angle θ.
Decomposing the z-axis Down state ($|\downarrow\rangle_z$) relative to the θ -axis yields:

$$|\downarrow\rangle_z = -sin\left(\frac{\theta}{2}\right)|\uparrow\rangle_\theta + cos\left(\frac{\theta}{2}\right)|\downarrow\rangle_\theta$$

According to the Born Rule, the probability of observing each state of Particle B is the square of the amplitude.
Probability of obtaining 'Up' on θ -axis :

$$P(up\ at\ \theta) = \left|-sin\left(\frac{\theta}{2}\right)\right|^2 = \sin^2\left(\frac{\theta}{2}\right)$$

Probability of obtaining 'Down' on θ -axis: :

$$P(dn\ at\ \theta) = \left|cos\left(\frac{\theta}{2}\right)\right|^2 = \cos^2\left(\frac{\theta}{2}\right)$$

The statistical correlation calculated from this angular re-alignment probability demonstrates that Bell's Inequality can be violated.
When the observation result of Particle A is Up (value +1), the average measurement result for Particle B is $(+1) \times P(up) + (-1) \times P(down)$. Calculating this yields:

$$E(\theta) = \sin^2\left(\frac{\theta}{2}\right) - \cos^2\left(\frac{\theta}{2}\right) = -cos(\theta)$$

Substituting this correlation $E(\theta) = -cos(\theta)$ into the CHSH Inequality and using a specific combination of angles (e.g., $0°, 45°, 90°, 135°$), the final result is:

$$|S| = 2\sqrt{2} \approx 2.828$$

In conclusion, this value violates 2, the limit of local realism. This formulation reinterprets the conventional quantum mechanical concept of "wavefunction collapse" as the alignment and re-alignment of particles caused by observation.

7.4.2 Quantum Leap via Vibration Cancellation

The phenomenon where an electron moves instantaneously from one orbit to another (Quantum Jump) clashes with conventional macroscopic physics. Instantaneous movement, rather than gradual transit, has historically been an intuitively difficult concept to grasp.
This theory explains this phenomenon through Relational Vibration Cancellation, analogous to the mechanism described for quantum entanglement.

When an electron receives an energy phase from light capable of inducing resonance, it begins to resonate with the light's vibrational energy. As the electron enters resonance and aligns with the light's phase, a phase shift occurs in both the electron and the light energy, leading to the phenomenon of Relational Vibration Cancellation.

The phase change induced by vibrational resonance can be expressed by the following equation:

$$tan(\phi) = \frac{b\omega}{m(\omega_e^2 - \omega_L^2)} \tag{7.4.2}$$

ω_e : Intrinsic frequency of the electron
ω_L : Frequency of the light energy

In this equation, when the frequency of the electron and the light energy become exactly equal, the denominator becomes zero, causing a 90° phase shift. According to the Law of Action-Reaction, this implies that the phase of the light energy also shifts by 90°.
However, due to the directional nature of the forces between the electron and light, if the electron's phase shifts by $+90°$, the light's vibration shifts by $-90°$ as a reaction. consequently, their phases become exactly opposite. This results in Relational Vibration Cancellation for the electron. The electron, now in a 0-Second State due to this cancellation, becomes capable of moving regardless of distance (instantaneous transport). However, upon reaching a point within the nucleus's vibrational field where resonance is possible (a stable orbital node), the phase relationship between the electron and the light energy is disrupted (the cancellation condition breaks), and the electron manifests in that resonant orbit. This shares the identical mechanism with the phenomenon where spin manifests via the act of observation in quantum entanglement.

7.4.3 Quantum Tunneling via Vibration Cancellation

Quantum Tunneling is a phenomenon where a particle passes like a phantom through a high energy barrier that far exceeds the particle's own energy capabilities. This theory explains this phenomenon not through the Relational Vibration Cancellation seen in Quantum Entanglement or Quantum Leaps, but through Local Vibration Cancellation occurring between the barrier and the electron.

The vibrations of the atomic nuclei constituting the barrier create a complex topography of energy and wavenumbers within the surrounding J-Field. When an incoming particle finds a resonance point on this topography that exactly matches its own intrinsic amplitude and wavenumber, tunneling is initiated. At the moment this resonance occurs, vibration cancellation happens, causing time to approach zero. Consequently, the particle transcends spatial constraints and passes through the barrier.
Factors such as the barrier's energy, temperature, structural arrangement (crystalline vs. amorphous), and thickness determine the complexity of this topography, thereby influencing the final tunneling probability.

To calculate the tunneling probability, we must first determine the maximum effective range over which the wave of a single atomic nucleus within the barrier exerts influence. This is derived from the condition that the wave's amplitude must be greater than the Planck Length (L_P).

$$Amplitude(r) = \frac{A_0}{r^{1.5}} \tag{7.4.3}$$

A_0 : Intrinsic initial amplitude of the atomic nucleus
$r^{1.5}$: Wave attenuation with distance

If the amplitude drops below the Planck Length, it ceases to exert influence; thus, the distance at which the amplitude equals the Planck Length is considered the interference distance.

$$Amplitude(r) > L_P$$

$$\frac{A_0}{r^{1.5}} > L_P$$

Rearranging this equation with respect to distance r, we formulate the relationship for the maximum influential distance (r_{max}).

$$r^{1.5} < \frac{A_0}{L_P}$$

$$r_{\max} = \left(\frac{A_0}{L_P}\right)^{\frac{2}{3}}$$

A_0 : Intrinsic initial amplitude of the atomic nucleus
$r^{1.5}$: Wave attenuation with distance
$r_{\max}$: Distance over which the wave generated by the nucleus exerts influence
L_P : Planck Length

Next, we calculate the Total Complex Wave Function (Ψ_{total}) of the space in front of the barrier by superposing the waves of all atomic nuclei (N) within the effective range ($r_{\max}$) that influence a specific point.
First, describing the wave created by each individual nucleus using the wave equation:

$$\psi_i(x, y, z) = \left(\frac{A_i}{r_i^{1.5}}\right) e^{i(k_i r_i)}$$

Summing these up, the Total Wave Function (Ψ_{total}) is:

$$\Psi_{total}(x, y, z) = \sum_{i=1}^{N} \left(\frac{A_i}{r_i^{1.5}}\right) e^{i(k_i r_i)} \tag{7.4.4}$$

Extracting the Energy Topography and Wavenumber Topography from this yields:

$$|\Psi_{barrier}(x, y, z)| = \sum_{i=1}^{N} \psi_i(x, y, z) = \sum_{i=1}^{N} \frac{A_i}{r_i^{1.5}} \cos(k_i r_i) \tag{7.4.5}$$

$$k_{barrier}(x, y, z) = |\nabla arg[\Psi_{barrier}(x, y, z)]| = \sqrt{\left(\frac{\partial \phi_{total}}{\partial x}\right)^2 + \left(\frac{\partial \phi_{total}}{\partial y}\right)^2 + \left(\frac{\partial \phi_{total}}{\partial z}\right)^2} \tag{7.4.6}$$

On these two maps, we locate the coordinates (x, y, z) of the resonance point that exactly matches the characteristics of the incident electron (A_e, k_e) using the following

Energy Resonance Condition : $|\Psi_{barrier}(x, y, z)| = A_e$

Wavenumber Resonance Condition : $k_{barrier}(x, y, z) = k_e$

Here, A_e and k_e represent the intrinsic amplitude and wavenumber of the electron incident from the exterior. The number of solutions (N) to this system of simultaneous equations determines the final probability of tunneling occurrence.
This probability is expressed as the ratio between the total wave interference area and the area where quantum tunneling is possible. This tunnelable area corresponds to the area of a circle defined by the Planck Length.

$$\frac{A_{tunnel}}{A_{barrier}} \tag{7.4.7}$$

A_{tunnel} : Area where tunneling is possible (Planck Area × N)
$A_{barrier}$: Area of the wave interference pattern centered on a single nucleus

The amplitude of the apparent vibration resulting from cancellation must not exceed the Planck Length. The moment it exceeds the Planck Length, interaction with the J-Field becomes possible; consequently, time begins to flow, and mass manifests. This disrupts the tunneling condition, rendering tunneling impossible. Therefore, tunneling becomes feasible only within specific sections corresponding to the Planck Area situated at the points where tunneling can occur.

Next, the barrier thickness can be described as a multi-layered structure of atomic scale. As the barrier thickens, the tunneling probability decreases exponentially.

$$P = \left(\frac{A_{tunnel}}{A_{barrier}}\right)^{(L/d_{atom})} \tag{7.4.8}$$

This implies that as the number of layers increases, the total probability rapidly approaches zero.

In conclusion, this explanation demonstrates that various aspects of quantum tunneling phenomena can be described through a consistent framework.
Resonant Tunneling Diode: This implies that the region where electron tunneling is possible changes based on current intensity, rather than the conventional quantum well explanation.

Elastic and Inelastic Tunneling: These can be explained based on the criterion of perfect vibration cancellation.
Elastic Tunneling occurs when the electron reaches the exact point of vibration cancellation.
Inelastic Tunneling occurs when the electron arrives slightly off-center, yet still within the Planck Area. In this case of "Incomplete Cancellation," the resulting amplitude is smaller than the Planck Length (allowing tunneling), but since it is not a perfect cancellation, energy loss and time delay occur.

We have reinterpreted the core phenomena of quantum mechanics from the perspective of Vibrational Cosmology. Rather than relying on the indeterministic, probabilistic interpretation of the quantum world, we have endeavored to explain all phenomena through the concrete dynamics of a single physical space: the J-Field.

8. Vibrational Cosmology

The Big Bang theory, the standard model of modern cosmology, explains that the universe began approximately 13.8 billion years ago from a singularity of extreme heat and density. However, this conventional theory fails to answer what existed before the Big Bang and what the true nature of the singularity was.

Vibrational Cosmology presents a new scenario regarding the birth, evolution, and future of the universe. In this theory, the beginning of the universe is not creation from nothingness (ex nihilo). Instead, it explains the past, present, and future of the universe—including the birth of space, time, and matter—through a single unified principle.

8.1 The Life Cycle of Our Cosmos

Before the Big Bang (The Previous Universe)

In a universe where every star has lost its light and every black hole has evaporated via Hawking radiation, only a minuscule number of final particles remain, having not yet decayed. The faint pressure of the waves generated by these particles is the only thing keeping the universe in a state of minute expansion. However, after eons pass, even these final particles unravel their knots and are annihilated, returning to the pure J-Field.

Finally, a state of perfect tranquility arrives, where neither matter nor waves exist, and the entropy of the J-Field reaches its minimum point.

Preparation for Birth (The Great Contraction)

The J-Field, having completely lost the final momentum for expansion, can no longer stretch outward and begins to contract due to its fundamental elastic force. All space in the universe pulls upon itself, retracting at a terrifying speed toward a single point.

This contraction does not cease at a singularity of infinite density. This contraction initiates in a realm where particles have been annihilated, meaning there are no waves caused by particle vibration to resist the collapse. Once contraction begins, it cannot be stopped. When the J-Field is compressed to the Planck scale—the minimum unit of the universe—its elastic resistance reaches its maximum.

Crucially, this contraction occurs anisotropically, thereby acquiring angular momentum.

The Big Bang (The Birth of Our Cosmos)

The J-Field, compressed to the extreme limit of the Planck scale, resembles a rubber sheet stretched (or compressed) to its breaking point. It releases all its stored energy in a single instant, expanding explosively. This is precisely the Singularity-Free Big Bang.

Inflation (Rapid Expansion of the J-Field)

The initial expansion driven by this elastic force is tremendously fast, causing the universe to grow to an unimaginable size in a fraction of a second. This expansion is accompanied by precession along with rotation, resulting from the anisotropic contraction of the J-Field of the previous universe.

The Era of Matter (Matter-Antimatter Asymmetry)

During this explosive expansion, the intensely vibrating J-Field formed knots, creating the first matter. Due to the rotation (angular momentum) of the J-Field at this moment, a directional bias occurred, leading to the Era of Matter, where matter came to dominate over antimatter. Driven by the tremendous vibration of the J-Field, matter was created at a rapid pace, generating enough substance to fill the universe as we know it today.

Furthermore, the rotation of this J-Field establishes a rotational axis in the universe, around which the knots rotate and form structures.

The Genesis of Large-Scale Structures and Holes in the Universe (Primordial Black Holes)

Upon the creation of matter, in accordance with the Pauli Exclusion Principle, the myriad newly formed particles could not overlap in the same state and thus repelled one another. This fundamental repulsion created minute density differences in the early universe, becoming the seeds of large-scale structures that would later form stars and galaxies.

However, as these minute density differences gradually grew, very small yet heavy seeds were formed. Even while matter was undergoing this repulsion, the J-Field was vibrating tremendously due to elastic expansion. This caused time to flow rapidly across the universe—a phenomenon of Time Acceleration.
Due to this rapid flow of time, the heavy seeds instantly transformed into Primordial Black Holes, effectively punching holes in the universe.

Unending Expansion of the J-Field (Dark Energy)
As the elastic force of the J-Field weakened and inflation neared its end, the rapid volumetric expansion made the J-Field's rotation nearly imperceptible due to the Conservation of Angular Momentum, though particles already filled the interior of the J-Field. As inflation concluded, the vibration of the J-Field also decreased sharply, leading to a drastic reduction in particle creation.
Now, as gravity pulled matter together to form stars and galaxies, it appeared as though the universe should stop expanding and begin to contract.
However, the supersolid nature of the J-Field and the waves generated by countless stars and galaxies filling the universe constantly pushed outward across the entire cosmos. Along with these waves, the annihilation of particles (via the unraveling of knots) returning energy to the J-Field acts as a source of energy that causes the J-Field's volume to continuously increase. As it grows larger, the rotation of the J-Field ceases to be visible, leaving nothing but its traces.

The Future and the Next Universe (Entropy)
This accelerated expansion will continue until matter and black holes disappear, leaving only the final particles. When even those particles perish, the J-Field will regain its tranquility and, driven by its own elastic force, begin preparing for the Next Universe.
Perhaps, in that next cycle, an Antimatter Universe may be born. A universe identical to ours, yet fundamentally different.

8.2 The Big Bang and Inflation of the J-Field

As explained in Section 8.1, the Big Bang is the moment when the contracted J-Field rebounds and unfolds. Crucially, there is no singularity where all matter condenses into a single point. Since the vibration of the J-Field occurs in Planck units, the repulsive force generated by this vibration prevents the J-Field from contracting smaller than the Planck Volume—the smallest unit of our universe.
The Inflation (Rapid Expansion) of the J-Field requires no separate assumptions (such as an Inflation field); it is driven solely by the elastic energy of the J-Field. It is analogous to a rubber sheet compressed to the Planck scale. Such a compressed sheet will expand instantaneously due to its stored elastic energy. This expansion generates tremendous vibrations within the J-Field.

The expansion rate of the early universe can be described using the Friedmann Equation. The Elastic Modulus of the J-Field was defined in Section 2.1 under the characteristics of the J-Field.

$$P_{p(J)} \approx 4.633 \times 10^{113}\ N/m^2$$

Applying this Elastic Modulus to the Friedmann Equation allows us to determine the expansion rate of the early universe**[13]**.

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3c^2}\rho - \frac{kc^2}{a^2} - \frac{1}{3\lambda c^2}$$

In this theory, the J-Field itself is flat ($k = 0$). There is only vibration caused by the expansion of the early universe. Therefore, the curvature term k becomes 0 and is removed. Furthermore, since the early expansion is explained by the elastic modulus of the J-Field itself, the Cosmological Constant term Λ is also unnecessary. Therefore, rearranging the equation from the perspective of Vibrational Cosmology:

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3c^2} P_{p(J)} \tag{8.2.1}$$

Calculating this equation:

$$\left(\frac{\dot{a}}{a}\right)^2 \approx \frac{8\pi(6.674 \times 10^{-11})}{3(3.0 \times 10^8)^2} \cdot (4.63 \times 10^{113}) \approx 2.87 \times 10^{87}\ s^{-2}$$

Now, taking the square root of both sides to find the Final Expansion Rate :

$$\left(\frac{\dot{a}}{a}\right) \approx \sqrt{2.87 \times 10^{87}} \approx 5.36 \times 10^{43}\ s^{-1} \tag{8.2.2}$$

Comparing this value with the predictions of conventional Inflation Theory**[14]**:

Vibrational Cosmology Prediction : $5.36 \times 10^{43}\ s^{-1}$
Standard Inflation Theory Prediction : $10^{42} \sim 10^{44}\ s^{-1}$

Comparing the two values reveals that they predict the same order of magnitude. This result is within the range predicted by current cosmology and demonstrates that this theory is consistent with established cosmological data.
Furthermore, once this elastic energy dissipates and the residual vibrations naturally cease, Inflation concludes naturally, and the universe transitions into the current era of expansion driven by Dark Energy.

8.3. The Beginning of the Material World

The material world we observe was forged by the immense vibration of the J-Field in the early universe, which generated particles. Simultaneously, the angular momentum arising from the anisotropic contraction of the J-Field determined the direction of the twist during particle creation, resulting in the matter we see today.

First, as explained in Section 3.2.1, matter creation occurs when the vibrational energy of the J-Field forces the J-Field to form knots.

$$J = \underbrace{2\mu^2 J}_{\substack{linear \\ restoring\ force}} - \underbrace{4\lambda\, |J|^2\, J}_{\substack{\text{nonlinear} \\ \text{confinement force}}}$$

Here, particles are created at stable positions where the linear restoring force and the nonlinear confinement force balance out.

The knots generated in this manner are created in equal quantities of negative (-) knots and positive (+) knots. Based on the particle tensor structure format in Section 3.2.2, the number of knots can be represented as shown below.

Particle	Electron	Up Quark	Up Quark	Total
Total Knots (n^2)	1	4	9	14
Knot Count (-)	-1	-1	-5	7
Anti-knot Count (+)	0	+3	+4	7

Table (8.3.1)

It can be observed that the total sum of knots and anti-knots constituting electrons, up quarks, and down quarks is exactly equal. This leads to the conclusion that our universe does not violate CP symmetry. In other words, the existence of matter should be interpreted not as a result of broken CP symmetry, but as a consequence of the universe's rotation**[15]**.

This can be explained by the Coriolis effect. The Coriolis effect is often illustrated by the phenomenon where water drains in a specific rotating direction due to the Earth's rotation when a toilet is flushed.

When applied to particles, this implies that due to the universe's rotation, twisting occurs in the direction of matter rather than antimatter during particle creation. Ultimately, this twisting resulted in our universe becoming a world of matter rather than antimatter.

The asymmetry between matter and antimatter arises because the structure acquires a twist during particle creation, driven by the initial rotation of the J-Field through a universal Coriolis effect. In this process, particles are formed centering on the knot (-), which aligns with the direction of the universe's rotation. Conversely, if a particle attempts to form around an anti-knot, the rotation of the J-Field interferes with the process, thereby suppressing the creation of antimatter.

This also explains the directionality of the Weak Force. The direction in which the knot unravels corresponds to the left-handed chirality of the Weak Force. In other words, the Weak Force manifests as an intrinsic characteristic of the particle's structure**[16]**.

The classical Coriolis Force is described as follows:

$$\overrightarrow{F_{Coriolis}} = -2m\left(\vec{\Omega} \times \vec{v}\right)$$

$\vec{\Omega}$: Angular velocity vector of the system
$\vec{v}$: Velocity vector of the object
× (Cross Product) : Operation of rotation, generating a force in the perpendicular direction

This Coriolis phenomenon is implemented as the Spin Term (S_{ijk}) in the Particle Tensor Equation of Vibrational Cosmology. The Spin Term of the Particle Tensor Equation is:

$$S_{ijk}(T) = \eta\left(\epsilon_{ilm}\,\partial_l T_{mjk}\right)$$

This Spin Term corresponds one-to-one with each element of the Coriolis equation:

$$\overrightarrow{F_{Coriolis}} \quad \longrightarrow \quad S_{ijk}(T) \tag{8.3.1}$$

$$\vec{\Omega} \times \vec{v} \longrightarrow \eta\left(\epsilon_{ilm}\partial_l T_{mjk}\right) \tag{8.3.2}$$

$\times\ (Cross\ Product) \rightarrow Levi - Civita\ Tensor\ (\epsilon_{ilm})$:
This transformation determines the handedness (chirality) and rotation direction of the particle.

$\vec{v}\ (Vector\ Velocity) \rightarrow Gradient\ (\nabla T)$:
This corresponds to the particle's tendency to change in space; the spatial gradient of the tensor acts as the velocity component.

$\vec{\Omega}\ (Rotation) \rightarrow Coefficient(\eta)$:
The rotation of the universe is already embedded in the coefficient of the spin term. If there were no initial

rotation, this term would be zero, and spin would not exist.

This explanation clarifies why our universe consists of matter rather than antimatter and why particles exhibit only left-handedness.

8.4 The Genesis of Large-Scale Structures and Primordial Black Holes

With the beginning of the universe, particles poured forth. The rate of particle creation exceeded the rate of spatial expansion, causing space to fill instantaneously. This resulted in a state of extreme density and temperature. However, even in this dense environment, fermions, abiding by the Pauli Exclusion Principle, refused to overlap in identical states, leading to imbalanced matter diffusion. Although the differences were minute, regions of slightly higher density emerged. These tiny discrepancies became the seeds for the universe's large-scale structures and the primordial giant black holes. These seeds were able to grow into the skeletal structures of the universe and primordial black holes due to the Time Acceleration caused by the immense vibration of the J-Field.

The condition of ultra-high temperature resulting from ultra-high density in the early universe is only possible if the particle creation rate exceeds the J-Field expansion rate. This is explained by comparing the expansion rate from the Friedmann Equation with the rate of matter creation driven by energy density. According to Einstein's formula $E = mc^2$, particle creation is possible only when the energy threshold exceeds the particle's rest mass. Within the J-Field, possessing immense energy density, massive material creation occurs.

The relationship between the matter creation rate and the spatial expansion rate is as follows:

Matter Creation Rate：

$$\Gamma_m = \frac{\rho_J}{\hbar} \tag{8.4.1}$$

J-Field Expansion Rate：

$$H = \sqrt{\frac{8\pi G}{3c^2}\,\rho_J} \tag{8.4.2}$$

Γ_m : Matter Creation Rate
H : J-Field Expansion Rate
ρ_J : Energy Density of the J-Field

The matter creation rate is proportional to the energy density itself, while the expansion rate of the J-Field is proportional to its square root. This mathematically demonstrates that the rate of matter creation was faster than the rate of J-Field expansion, explaining the hyper-density of particles in the early universe.
To explain the skeletal framework of large-scale structures and primordial black holes, local density differences are required. These are caused by the random diffusion of matter driven by the characteristics of fermions—specifically, the Pauli Exclusion Principle. The density differences in the early universe arise from this random diffusion, described by the diffusion equation of Statistical Mechanics.

$$\frac{\delta\rho}{\rho_{avg}} \approx \frac{1}{\sqrt{N}} \tag{8.4.3}$$

$\delta\rho/\rho_{avg}$ ：The magnitude of relative density difference in a specific region compared to the overall average density.
N : The total number of particles within that specific observed region.

Although the universe appears highly uniform on a global scale, entering microscopic regions reveals significant density differences—voids where particles repelled one another, and clumps where they gathered.

These minute density differences resulted in the formation of our universe's large-scale structures**[17]**. Furthermore, galaxies were born possessing angular velocity due to the initial angular momentum of the early universe. However, due to Inflation and the subsequent expansion driven by Dark Energy, the Conservation of Angular Momentum dictated that the universe's angular velocity slow down drastically, becoming imperceptible today.
Yet, invisible does not mean nonexistent. This can be confirmed through the rotation direction of galaxies. Due to the Coriolis Effect, the rotation of the universe manifests as the rotational alignment of galaxies. This explains the phenomenon where galaxies appear aligned in specific directions.

The rotation of this universe extends to explaining the formation of the Eridanus Supervoid and the Axis of Evil **[17]**. While existing explanations have attributed these features to statistical coincidence or unknown phenomena, this theory interprets them as alignments resulting from the rotation of the early universe.

While the initial rotation suppressed antimatter creation and promoted matter generation, this rotational speed significantly decreased with the expansion of the J-Field, which in turn intensified the precession of the J-Field''s rotation. The evidence for this is precisely the Eridanus Supervoid and the Axis of Evil.

The large and irregular shape of the Eridanus Supervoid can be explained as a result of the increased precession of the rotational axis as the rotation of the J-Field slowed. Furthermore, the reason the Axis of Evil appears as a curved form rather than a straight aligned line can be explained as the cosmic equator manifested by this precession.

These are phenomena that arise because the universe rotates with a specific direction; just like the weak force in particles, they are manifestations caused by the universe's rotation.

Nevertheless, the reason our universe appears isotropic is that the angular velocity decreased drastically due to inflation before the diffusion of matter began. This results in our universe appearing isotropic."

Now, the essential concept required to explain the Primordial Supermassive Black Holes is "Time Acceleration." This posits that the speed of time in the early universe was different from the speed of time today. This is explained by combining Section 3.1 (Emergence of Time via Vibration) with the Planck-Einstein relation.

$$dt = \frac{d\theta}{\omega} \qquad\qquad E = \hbar\omega$$

Using these two equations, we can explain that higher energy implies higher frequency, which in turn means that the duration of "1 second" itself becomes shorter (i.e., time ticks faster). Due to the elastic energy of the early universe, a tremendous frequency difference existed compared to the current energy density. The reason we perceive a uniform speed of time today is that we share the fundamental vibration of the J-Field. This acts like an electrical ground, serving as the minimum condition for the time we experience.

In the early universe, this "ground value" was different. This difference in frequency generated Time Acceleration.

$$\frac{\mathrm{d}t_{in}}{\mathrm{d}t_0} = \frac{\omega_{in}}{\omega_0}$$

$$dt_{in} = \frac{\omega_{in}}{\omega_0} \cdot dt_0 \tag{8.4.4}$$

dt_{in} : Speed of time during Inflation

dt_0 : Speed of time in the current universe
ω_{in} : Frequency of the early universe
ω_0 : Frequency of the current universe

This implies that the frequency generated by the early cosmic elastic energy caused massive Time Acceleration. From a hypothetical perspective outside the universe, this might appear as a fleeting instant. However, from inside our universe, vast amounts of time were passing.
This generated a sufficient flow of time for the seeds of black holes to grow into Supermassive Black Holes.

8.5 The Era of Dark Energy

After the inflation driven by the elastic energy of the J-Field concluded, it appeared as though the universe would collapse back into a single point due to the gravity of matter. However, due to the inherent rigidity of the J-Field, matter is embedded within it like raisins in a loaf of bread, moving further apart as the J-Field expands**[18]**.

In this theory, Dark Energy is explained by the supersolid characteristics of the J-Field, the waves generated by the vibration of all matter in the universe, and the "spatialization" of particles resulting from the unraveling of knots.
As all matter vibrates, it generates waves in the J-Field. The vibrations produced by every particle in the universe create these waves, which become the driving force for the expansion of our universe.

In Section 2.1, we defined the J-Field as a supersolid. Due to its frictionless supersolid nature, the Longitudinal Waves (P-waves) and Transverse Waves (S-waves) of the J-Field propagate at the same speed. This implies that the J-Field expands due to the waves generated by particles.
Wave propagation in solids is a familiar concept, often learned in Earth Science as P-waves and S-waves. In ordinary solids, P-waves travel faster than S-waves. The difference in arrival times of these two waves allows seismologists to locate the epicenter of an earthquake.

However, since the supersolid J-Field is frictionless, the propagation speeds of P-waves and S-waves are identical.

$$J_{wv} = \sqrt{\frac{P_p}{\rho_p}} = \sqrt{\frac{c^7/\hbar G^2}{c^5/\hbar G^2}} = c$$

If the propagation speeds of two fundamentally different waves are the same, we reach the conclusion that expansion is occurring.
The wave speeds in a solid are defined as follows:

$$P - waves\ \ v_P = \sqrt{\frac{K + \frac{4}{3}\mu}{\rho}} \qquad\qquad S - waves\ \ v_S = \sqrt{\frac{\mu}{\rho}}$$

K : Bulk Modulus (Force resisting compression/volume change)
μ : Shear Modulus (Force resisting twisting/shearing)
ρ : Density of the medium

Here, if the P-wave and S-wave speeds are equal ($v_P = v_S$), we can write:

$$\sqrt{\frac{K + 4/3\ \mu}{\rho}} = \sqrt{\frac{\mu}{\rho}}$$

Rearranging this equation yields:

$$K = -\frac{1}{3}\mu \tag{8.5.1}$$

This results in a negative value (-) for the Bulk Modulus (K). Since the Shear Modulus (μ) must always be a positive value (+) if the medium physically exists, K inevitably takes a negative value. A negative Bulk Modulus means that instead of resisting compression, the medium resists contraction—in other words, it tends to expand. This signifies that the waves generated by the vibration of all particles in the universe act to expand the entire cosmos.

Gravitational Waves are explained as S-waves (Transverse Waves), propagating while vibrating perpendicular to the direction of travel. Then, what corresponds to the P-waves (Longitudinal Waves)?

P-waves are precisely Light, or Electromagnetic Waves.

Conventional physics describes light as a transverse wave because its oscillation is perpendicular to its direction of travel. This description is consistent within that framework. However, in this theory, the reason is that light vibrates; it does not mean it propagates purely as an S-wave mechanism of the medium. Because light vibrates, it exhibits properties of both transverse and longitudinal waves within the supersolid J-Field.
The characteristics of light are explained in Section 9.2

In conclusion, Dark Energy is a phenomenon that manifests because Gravitational Waves (particles' S-waves) and Electromagnetic Waves (particles' P-waves) propagate at the same speed within the J-Field.
This interpretation provides a mechanism to explain the Hubble Tension, the Cosmic Anisotropy problem, and the discrepancy between the expansion rates inferred from the Cosmic Microwave Background (CMB) versus current observations.**[18]**

Another factor contributing to cosmic expansion, albeit perhaps less significant than the wave equality mentioned above, is particle decay. In Section 3.2, particles were defined as knots in the J-Field. Particle decay signifies the particle returning to the form of the J-Field (space). This process restores volume to the field, thereby contributing to cosmic expansion.
Thus, the reason for the universe's expansion can be explained by two factors: the characteristics of a frictionless supersolid and the annihilation (spatialization) of particles.

Why, then, do the interiors of galaxies not expand?

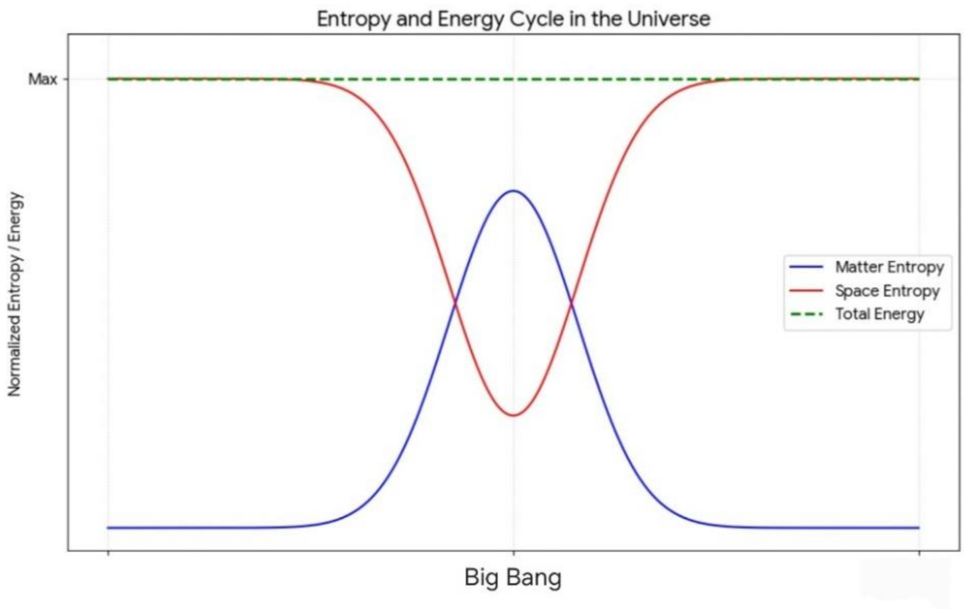
This is explained by the tension created when matter presses against the J-Field. Just as it is difficult for an extremely taut rubber band to vibrate, the high tension within a galaxy suppresses the propagation of waves (the expansion driving force). This tension inhibits the waves inside the galaxy, thereby preventing local expansion while the universe expands on the large scale.

8.6 The End of Our Cosmos

After an immense period of time passes, the knot of the very last particle unravels, and every particle in the universe vanishes. Consequently, there are no waves left to induce vibration in the J-Field. The driving force of cosmic expansion disappears, leaving only the static J-Field. Thus, the entropy of the J-Field reaches its minimum state.

Upon reaching this state of minimum entropy, the J-Field converges toward a single point at the Planck scale, eventually reaching a state of maximum entropy (in terms of potential). From this state, it unfolds again driven

by the elasticity of the J-Field, initiating the universe once more.
This implies that the maximum point of Material Entropy corresponds to the minimum point of Spatial (J-Field) Entropy. If our universe is a closed system, this inverse correlation of entropy will always be conserved.



Graph (8.6.1)

This theory posits that the true protagonist of the universe is not matter, but Space itself. We, the matter that constitutes us, and furthermore, all matter in the entire universe, are merely secondary phenomena resulting from the vibration of the J-Field. Additionally, traces of the previous universe might be discovered in the Cosmic Microwave Background radiation.

However, this theory does not explain where or how the J-Field originated. Whether our universe is truly a closed system, whether the vibration was caused by the collision of membranes as in M-theory, whether other universes exist, or whether there are dimensions higher than ours—these are impossible to explain within this framework.

However, within the bounds of our universe, this theory offers a comprehensive explanation of why and how these phenomena occur.

9. Mysteries of Our Universe

In the preceding chapters, we examined the Theory of Relativity, Quantum Mechanics, and Cosmology through the lens of Vibrational Cosmology. In this chapter, we will address other unresolved mysteries from this perspective and explore their underlying causes.

9.1 The Time of Light

Both this theory and the Theory of Relativity explain that time becomes zero when traveling at the speed of light. However, this renders the very concept of the "speed of light" somewhat paradoxical. Light travels at the speed of light under all circumstances; this is an invariant phenomenon. If light travels at the speed of light (where time is zero), it should theoretically arrive simultaneously with its departure. However, we know the speed of light, and we observe and perceive that light changes over time.

For instance, light departing from the Sun takes approximately 8 minutes and 45 seconds to reach Earth. Why, then, is light observed to travel with the passage of time?

In this theory, for particles with mass, reaching the speed of light causes $sin\theta$
to become 0, resulting in time becoming 0. Time becoming zero implies that distance loses its meaning. In other words, arrival occurs simultaneously with departure. This can be described as teleportation, akin to a quantum leap. Of course, it is impossible for a particle with mass to actually reach the speed of light.

However, in this theory, vibration generates time. Light also vibrates.

$$E_{photon} = \hbar\omega$$

The fact that light vibrates means that time flows for it, according to the First Axiom of this theory.

$$dt = \frac{d\theta}{\omega}$$

This implies that light also "ages." This explains the redshift of light.

This explanation of redshift gives rise to another issue: the explanation of time dilation. The phenomenon where distant supernova explosions appear to occur in slow motion could not be explained by the previous "tired light" hypothesis. However, this theory explains it through the change in the flow of time for light itself. As light travels over vast distances, its frequency gradually decreases over time. This signifies that the flow of time for the light itself has slowed down. Therefore, the reason supernova explosions appear to be slowed down is explained by the fact that the flow of time for the light itself has decelerated.

9.2 Light

Light has been a subject of mystery for a long time. In this section, we attempt to explain the characteristics of light. Light behaves like a particle and travels at the speed of light, yet it possesses no mass and exhibits the properties of a transverse wave (S-wave). This is explained as resulting from the characteristics of the J-Field.

We have previously explained that the density of the J-Field corresponds to the immense Planck density. Light is a longitudinal wave (P-wave) of this J-Field. However, within the J-Field, compression due to the longitudinal wave barely occurs. The density difference with the surrounding J-Field converges to zero. Consequently, its mass also converges to zero.

$$\rho_J \approx \rho_{photon} \tag{9.2.1}$$

However, since it fundamentally possesses the nature of a longitudinal wave, its mass is not strictly zero.

This characteristic is akin to Newton's cradle.

Figure (9.2.1)

Consider steel balls as perfectly elastic bodies. When the kinetic energy of the blue ball is transferred through the silver balls to the red ball, there is almost no energy loss. While the kinetic energy is being transferred, the intermediate silver balls barely move, yet the energy is transmitted, causing the red ball at the end to bounce upward.

Similarly, the energy of the J-Field is transferred in the same manner. Light is fundamentally based on the properties of a longitudinal wave. However, due to the characteristic of the J-Field being a perfectly elastic body, the energy as a longitudinal wave barely manifests, and it appears mostly as a transverse wave. The energy remaining from the longitudinal wave manifests as angular momentum and frequency in this transverse wave. This very angular momentum appears as the Planck constant.

$$L_J \, \omega = \hbar\omega \qquad (9.2.2)$$

In summary, light appears as a longitudinal wave of the J-Field, creating a density difference with the surrounding J-Field that converges to zero. This density difference causes light to behave like a particle, but compels its mass to be so small that it converges to zero. Since light can barely utilize its energy as a longitudinal wave, it manifests in the form of a transverse wave. This results in the vibration of light, possessing angular momentum and frequency, thereby exerting momentum like a particle. This vibration generates the flow of time and appears as the cause of redshift.

9.3 The Principle of Least Time for Light

The principle of least time for light is similar to the principle explained in Section 7.3 regarding particle duality and the double-slit phenomenon. Superimposed waves generated by particles are spread out along the path that light traverses. Light travels according to the Principle of Least Action, following these waves and the interference patterns they create. This implies that light does not essentially "know" the path of least time beforehand; rather, it travels along a path that has already been established..

The map of waves generated by particles is described by the energy distribution equation of the J-Field Equation.

$$\Box J - \mu^2 J + \lambda J^3 = 0$$

The waves manifesting in this manner induce additional interference with the existing patterns caused by particles and light. Light traversing this interference pattern moves according to the Principle of Least Action. This is precisely the Principle of Least Time for Light.

$$K(B, A) = \int \mathcal{D}[x(t)] e^{\frac{iS[x(t)]}{\hbar}} \qquad (9.3.1)$$

This logic dispels the illusion that light engages in cognitive processes and explains the phenomenon as a mechanical interaction. The principle of least time for light suggests that the path is generated by the waves light itself creates, and the light simply "slides" along its direction of travel.

9.4 The Hierarchy Problem of Forces - Electromagnetic, Weak, Strong Forces, and Gravity

The interactions of particles in our universe are explained by four forces: the Electromagnetic Force, the Weak Force, the Strong Force, and Gravity. Until now, it has been considered that the electromagnetic, weak, and strong forces are unified, and various attempts are being made to integrate gravity into this framework. However, in this theory, Gravity is defined as a force fundamentally different from the other three forces. Since Einstein's General Relativity, gravity has been explained as surrounding matter falling along the curvature caused by the warping of space.

This implies that gravity does not act due to a direct force exerted by the particle itself; rather, an object creates curvature in space, and other objects fall along that spatial curvature. Therefore, Gravity must be explained as an indirect force mediated through the J-Field, unlike the other three forces which manifest as direct particle interactions .

As explained in Section 5.1, this indirect force propagates through 4-dimensional spacetime at the speed of light. The three forces representing direct interactions do not disperse at the speed of light but act directly as particle-to-particle interactions.

This is analogous to comparing a boxer directly punching a sandbag (direct forces) to the wind created by the movement of the fist (gravity) ..

9.5 Dark Matter

In Section 3.2, particles were represented in the form of matrices (tensors). Dark matter can also be represented using the same approach. This dark matter is defined as a particle with significant mass but zero electromagnetic force, characterized by $n = 4$ and thus $n^2 = 16$.

It possesses a three-dimensional volumetric structure formed by 16 knots

$$T_u = \left\{ \underbrace{\begin{pmatrix} -1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & -1 \end{pmatrix}}_{-1z} \underbrace{\begin{pmatrix} +1 & +1 & +1 \\ +1 & 0 & +1 \\ +1 & +1 & +1 \end{pmatrix}}_{0z} \underbrace{\begin{pmatrix} -1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & -1 \end{pmatrix}}_{+1z} \right\}$$

This shape takes the form of a cube with no knot in the center. With eight negative twist knots and eight positive twist knots, the electric charge is as follows:

$$Electric\ Charge(Q) = \frac{\sum Knots\ \ (0)}{Space\ Dimension(\ 3)} = 0 \tag{9.5.1}$$

Its structure can be viewed as a stable form with symmetry, as shown below.

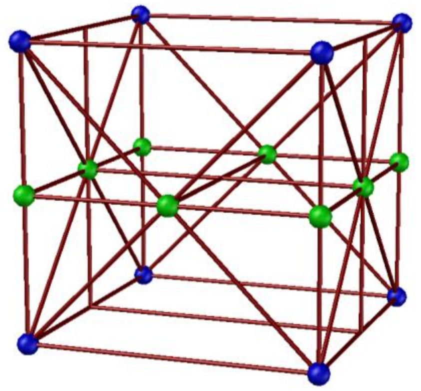


Figure (9.5.1)

The mass of this dark matter candidate can be calculated using the particle mass calculation formula presented in Section 3.2.3.

$$M[MeV] \approx -\frac{0.594516}{n^2} + (0.522363 \cdot n^2) + (0.583153 \cdot Q^2)$$

Particle	Knot No. (n^2)	Charge (Q)	Theoretical Value (MeV)
Dark Matter	16	0	8.32065

Table (9.5.1)

This mass corresponds to the mass of the particle proposed as a candidate for dark matter. Nucleons possess a similar mass (energy). The energy of nucleons ranges from 7.07 MeV for Helium to 8.79 MeV for Iron. This suggests the possibility that dark matter might not be a single individual particle, but rather an invisible particle that constitutes an atomic nucleus structure.

9.6 The Black Hole Information Paradox

The question "Is information in a black hole conserved?" has been a source of controversy. This theory asserts that information does not vanish but returns to its original form. Black hole evaporation proceeds via three phenomena .

The first is the escape of particles through Quantum Tunneling. Inside the black hole, the tremors of countless particles generate numerous phase cancellations and reinforcements. Among them, particles that undergo perfect phase cancellation manage to escape. At this moment, the particle's information is perfectly preserved and emerges outside the black hole. This constitutes the preservation of the original information .

The second is Quantum Entanglement. Outside the event horizon, the curvature of the J-Field deforms the field's vibration, manifesting as a vibration pattern capable of creating localized particles. Among the pair of particles created, the antiparticle falls into the black hole, annihilates with a particle inside, and generates energy. This energy is transferred to the partner particle, allowing it to escape as a complete knot-formed particle. This particle appears outside the black hole carrying identical information to the particle that vanished inside. This constitutes preservation as a copy of the information**[19]**.

The third is the Unraveling of the Knot. Similar to the half-life of matter, the particle itself undergoes a quantum tunneling phenomenon, decaying spontaneously, releasing energy, and returning to the form of the J-Field. In this theory, particles are phenomena that emerged during the rapid expansion of the primordial single field, the

J-Field. The unraveling of a particle's knot back into the J-Field signifies a return to its original form of information, manifesting as an increase in material entropy. This constitutes a transformation of information .

Black hole evaporation can thus be viewed as occurring through these three forms. All these forms preserve information, while the unraveling of knots appears as an increase in material entropy.

9.7 The Arrow of Time and Entropy

Time is irreversible and flows in only one direction. We know this through our experience of the world we live in. In this theory, the directionality of time arises from the initial conditions of our universe, generating irreversible time.

This originates from the Lagrangian in Section 2.3, the starting point of this theory.

$$S_J = \int \mathcal{L}_J \sqrt{-g}\, d^4x$$

$$\mathcal{L}_J = \frac{1}{2}\, g^{\mu\nu}(\partial_\mu J)(\partial_\nu J) - V(J)$$

The Euler-Lagrange equation derived by applying the Principle of Least Action to this is as follows:

$$\frac{1}{\sqrt{-g}}\partial_\mu \left(\sqrt{-g}\, g^{\mu\nu}\frac{\partial J}{\partial_\nu}\right) = -\frac{\partial V}{\partial J} \qquad (9.7.1)$$

To describe the expansion of the universe, we use the FLRW (Friedmann-Lemaître-Robertson-Walker) metric**[20[**.

$$g_{\mu\nu} = diag(c^2, -a(t)^2, -a(t)^2, -a(t)^2)$$

$$g^{\mu\nu} = diag\left(\frac{1}{c^2}, -\frac{1}{a(t)^2}, -\frac{1}{a(t)^2}, -\frac{1}{a(t)^2}\right)$$

$$\sqrt{-g} = c \cdot a(t)^3 \qquad (9.7.2)$$

Substituting the FLRW metric into the Euler-Lagrange equation and calculating J separately for time and space yields the following. First, calculating for time:

$$\frac{1}{ca^3}\,\partial_t\left(ca^3 \cdot \frac{1}{c^2}\frac{\partial J}{\partial t}\right) = \frac{1}{a^3}\,\partial_t\left(\frac{a^3}{c^2}\frac{\partial J}{\partial t}\right)$$

Differentiating this gives:

$$\frac{3\dot{a}}{ac^2}\frac{\partial J}{\partial t} + \frac{1}{c^2}\frac{\partial^2 J}{\partial t^2}$$

Now, calculating the spatial term yields:

$$\frac{1}{ca^3}\,\partial_i\left(ca^3 \cdot -\frac{1}{a^2}\frac{\partial J}{\partial i}\right) = -\frac{c}{a^3}\,\partial_i\left(a\frac{\partial J}{\partial i}\right)$$

Organizing this and summing over all spatial directions results in:

$$-\frac{c^2}{c^2a^2}\nabla^2 J = -\frac{1}{a^2}\nabla^2 J \tag{9.7.3}$$

Combining the calculated time and space terms results in the following:

$$\frac{1}{c^2}\frac{\partial^2 J}{\partial t^2}+\frac{3\dot{a}}{ac^2}\frac{\partial J}{\partial t}-\frac{1}{a^2}\nabla^2 J=-\frac{\partial V}{\partial J}$$

Finally, introducing the Hubble parameter $H = \dot{a}/a$, multiplying both sides by c^2 to consider effects in the physical coordinate system, and normalizing with $a = 1$, we obtain:

$$\frac{\partial^2 J}{\partial t^2}+3H\frac{\partial J}{\partial t}-c^2\nabla^2 J=-\frac{\partial V(J)}{\partial J} \tag{9.7.4}$$

Here, the term $3H \cdot (\partial J/\partial t)$ is interpreted as the "Arrow of Time" term, which forces the direction of time to flow one way. If time were reversed $(-t)$, the sign of the field flow $(\partial J/\partial t)$ would also become negative. This change in sign would act as an anti-friction force accelerating the field flow, creating a physically impossible situation. Consequently, the expansion of the universe induces asymmetric temporal friction, making it impossible for processes to proceed in the reverse direction. The meaning of the term $3H \cdot (\partial J/\partial t)$ implies that the phenomenon of phase transition descending from the peak of the energy hill to lower energy, caused by the Higgs potential in Section 2.1, is irreversible.

This is akin to a boulder rolling down from a mountain peak. A boulder rolling down does not roll back up to the peak on its own. Reversing time would imply the boulder ascending the peak solely through an increase in entropy without any external force, which is physically impossible.

Similarly, the energy of the J-Field, having descended to a low-energy state, cannot spontaneously ascend to a high-energy state without external force.

This explains why time flows with directionality.

The second reason is that the total frequency of our universe is irreversible. The number of vibrations that have already occurred cannot be reduced. This explains the irreversibility of time.

$$dt = \frac{d\theta}{\omega}$$

Here, since dt and $d\theta$ are proportional, the above equation can be expressed as:

$$T = \frac{1}{f} \tag{9.7.5}$$

The number of vibrations that began with the universe's inception cannot be reversed. Even if broken glass were reassembled, it would not mean the flow of time has reversed.

This is also explained in conjunction with entropy and directionality. In Section 8.6, the entropy connection between the J-Field and matter was defined, and the irreversibility of time was explained previously. Applying the Second Law of Thermodynamics to this explains why entropy proceeds in the direction of increase. Energy moves from high to low states, and this movement continues until an energy equilibrium is found. This phenomenon is the process of the Second Law of Thermodynamics changing over time. The directionality of time explained earlier guarantees this. This increase in entropy is the phenomenon of particles returning to space; reconstructing them back into the form of particles requires a tremendous condensation of energy. The probability of such energy condensation occurring is close to zero. Therefore, the entropy of the material world inevitably proceeds in the direction of increase.

The mysteries discussed thus far are no longer isolated, unrelated issues. These phenomena are inevitable consequences stemming from the physical characteristics of the single entity known as the J-Field —which forms the foundation of our theory—as well as the geometric structure existing upon it and the phenomenon of the emergence of time via vibration.

10. Predictability of Vibrational Cosmology

This theory presents a perspective distinct from existing theories. From this different perspective, we attempt to list phenomena that can be cautiously predicted.

10.1 Step-by-Step Double Slit Experiment

Previously in Section 7.3 regarding particle duality, we explained how the act of observation collapses the particle's wave nature. Here, we propose a concrete experiment.

1. The initial experimental setup is arranged like the conventional double-slit experiment with a particle launcher, a double slit, and a screen.
2. Observation equipment is installed immediately behind both slits to collapse the wave nature of the particles passing through them.
3. A second double slit is fabricated and installed behind one of the slits of the first double slit.
4. A barrier is installed to block the path from the other slit (of the first double slit) to minimize its influence on the final screen.
5. A final screen is installed behind the second double slit to observe interference patterns.

The purpose of this experiment is to confirm the regeneration of the particle's wave nature caused by observation, as explained in Section 7.3. This implies that a particle can exhibit wave properties again after observation.
If interference patterns appear again on the second screen, this would yield a result different from the Copenhagen interpretation, which states that an observed particle's wave nature collapses and cannot be reversed. In this theory, it is explained that a particle generates waves by shaking the space known as the J-Field. This indicates the possibility that the particle can generate interference patterns on the second screen as well.

This experiment is expected to be the decisive test determining the success or failure of this theory.

10.2 Mass Change Due to Quantum Entanglement

The meaning of vibration cancellation can manifest as a phenomenon of mass reduction.

$$E = mc^2 = \hbar\omega$$

$$m = \frac{\hbar\omega}{c^2}$$

While the mass change due to partial vibration cancellation of particles may be too minute to measure, we propose one experiment. It involves a lever and a laser interferometer, though it is uncertain if current technology allows for such measurement. The experimental design is as follows:

1. Suspend quantum entanglement generators of equal size and weight on both sides of a lever to balance the weight.
2. Configure one side to generate entanglement, while the other side receives the same energy input but does not generate entangled particles.
3. Attach mirrors to the bottom of the outer walls of both quantum entanglement generators to reflect light.
4. Install additional mirrors below these to bend the light by 90 degrees.
5. Shoot lasers to the bottom of both quantum entanglement generators and use the reflected light to create a laser interferometer to measure interference patterns.
6. Now, turn on the quantum entanglement generators and measure the changes in the interference pattern.

In this experiment, if the mass on the side generating entangled particles becomes minutely smaller, it would serve as proof of entanglement caused by vibration cancellation. In this experiment, generating a larger number of entangled particles is more important than precise control of the entanglement.

10.3 Dynamic Dark Energy and Hubble Tension

Dark energy was explained not as a fixed constant, but as the result of waves generated by the vibration of all matter in the universe. It is the expansion of space resulting from pressure and the return of particles to space. Therefore, the effect of dark energy may vary slightly in each direction depending on the distribution of matter in the universe. This suggests that the currently observed 'Hubble Tension' (the discrepancy in measurements of the cosmic expansion rate) might not be a measurement error, but a real physical phenomenon arising from the non-uniform distribution of matter in our local universe.

Using space telescopes, we can precisely measure the recession velocities of specific celestial bodies and compare them with the galaxy distribution map in that direction. If a systematic correlation is found—such as the expansion rate being slightly faster in directions with higher matter density—it could validate this theory.

10.4 Traces of Cosmic Rotation

To summarize, Chapter 8, "Vibrating Cosmology," explained that the generation of matter in our universe, the handedness of the weak force, the direction of galactic rotation, the Eridanus Supervoid, and the "Axis of Evil" are all phenomena caused by the rotation of the J-Field. This rotation is an inevitable consequence of anisotropic contraction and can be viewed as a legacy left by the previous universe. This phenomenon of rotation inevitably establishes rotational axes at the north and south, and generates an equator perpendicular to these axes.

The shape of the universe predicted by this theory posits that the universe has a center, with hourglass-shaped voids existing above and below this center, which would be formed perpendicular to the Axis of Evil. In other words, the Eridanus Supervoid corresponds to the lower section of the hourglass, and another similar supervoid must exist on the opposite side of the universe.

That other supervoid is precisely the KBC Void, within which our Milky Way galaxy is located. This void spans 2 billion light-years and is situated directly to the north of our galaxy. Comparable in size to the 1.8 billion light-years of the Eridanus Supervoid, these two massive voids constitute the rotational axis of the universe.

Although not perfectly perpendicular to this axis, the "Axis of Evil" is aligned at a significant angle, and it is here that the Supergalactic Plane is formed. The deviation from a perfect perpendicular alignment can be interpreted as a result of the precession of the J-Field.

While the universe itself appears spherical or ellipsoidal, the distribution of matter assumes a doughnut (toroidal) shape, featuring an hourglass-shaped void running through the center.

10.5 Tunneling Time Measurement

The concept of '0 seconds' due to vibration cancellation can find clues for verification in quantum tunneling phenomena. Incomplete vibration cancellation occurring during inelastic tunneling induces a minute time delay. By using attosecond lasers to directly measure the time it takes for an electron to pass through a nanometer-thick barrier, if the tunneling time is not always zero but shows a consistent time delay value matching the prediction of the incomplete cancellation model, it would support this theory .

11. Limitations of Vibrational Cosmology

This theory has been based on the J-Field. However, it cannot explain the origin of the J-Field itself or how it began. Furthermore, it cannot explain whether the current J-Field-based universe represents the limit or the beginning of dimensions, whether additional dimensions exist, or if there are other universes beyond our own.

11.1 Axiom – Not Circular Reasoning, but Cyclic Logic

The core foundations of this theory are the First and Third Axioms.

The First Axiom, "Emergence of Time via Vibration," explains vibration by swapping the positions of dt and ω in the standard formula. This perspective shifts the view from "how much phase change occurred per unit of time" to "time is generated by the phenomenon of vibration and the change in phase angle($d\theta$)". Since the unit of vibration is $1/t$, this could be seen as defining time using time.

However, this is the only unit available to describe the phenomenon of vibration ($1/t$). This should be understood as a conceptual shift: the phenomenon of vibration generates time.

The Third Axiom defines the characteristics of the J-Field using Planck units. These units are derived from G and c. Using these derived units to re-derive G and c may appear to be circular reasoning.
However, this should be regarded as a "Phenomenological Axiom." Just as in the analogy of Wittgenstein's Ladder, once we have used the ladder (observed values G and c) to climb up to the next level (Planck units), the ladder must be discarded.

The act of discarding the ladder involves explaining the universe with Mass Pressure (kg/m^2) and the Wave Propagation Speed of the J-Field ($\sqrt{P_p/\rho_p} = c$) as fundamental principles, rather than treating the speed of light or gravitational constant as fundamental.

11.2 Invisibility of the J-Field and Possibility of Indirect Verification

In Chapter 2, regarding the characteristics of the J-Field, we stated that direct detection of the J-Field is impossible. This explanation inherently implies unfalsifiability. We acknowledge that unfalsifiability acts as a weakness for a scientific theory.

However, even if direct verification is impossible, we have presented methods for indirect verification. We have proposed verification methods unique to this theory, such as the step-by-step double-slit experiment, mass change in entangled particles, and the relationship between Hubble tension and matter distribution.

While these indirect verification methods may not compare to direct verification, they serve as the "Kill Switches" for this theory. If interference patterns do not appear on the second screen, or if there is absolutely no correlation between Hubble tension and matter distribution, this theory must inevitably be discarded.

12. Comparison of Perspectives with Existing Theories

Thus far, the concepts presented have offered interpretations distinct from the conventional explanations of the Theory of Relativity and Quantum Mechanics. These shifts in perspective do not imply that existing theories or mathematical descriptions are incorrect; rather, this theory is proposed to view them from a different angle.

For instance, the thought experiment of a light clock inside a train, which explains Special Relativity, can be reinterpreted. If viewed from a different perspective, the vertical oscillation of light can be explained as a phase change caused by the change in the train's velocity.

As such, by altering our perspective, existing theories can be explained in a new light.

12.1 Comparison of Perspectives with Conventional Physics Theories

Concept	Standard Physics Theory	Vibrational Cosmology
Fundamental Nature of Universe	Spacetime + Matter/Energy (Dualism) - Matter appears upon empty space.	Single Entity J-Field (Monism) - Space creates matter.
Essence of Time	Independent Fundamental Dimension	Product of Vibration - Perception of changes in vibration.
Essence of Space	Geometric Background - 3D Space + 1D Time.	The J-Field Itself - The medium, the J-Field, is Space.
Definition of Particles	Excitations of Quantum Fields during Big Bang - Point particles.	Creation via J-Field Vibration - 3D structures formed by knots of space.
Forces	Gravity - Curvature of space (Empty but curved) EM Force - Exchange of virtual photons Weak Force - Exchange of W/Z bosons Strong Force - Exchange of gluons	Gravity - Curvature of J-Field EM Force - Linear waves between particles Weak Force - Structural collapse and reconstruction of particles Strong Force - Structural binding of particles
Constants	Values determined by observation or measurement.	Values derived from the characteristics of the J-Field.
Time Dilation	Geometric necessity derived from Invariance of Light Speed (Axiom).	Change in time flow due to Phase Change of Vibration.
Length Contraction	Space physically contracts due to velocity.	Space remains invariant; it is an illusion caused by time dilation.
Inertia	Property of an "object" to maintain its state of motion.	Repulsive force of "Space" resisting deformation caused by the object's pressure.
Uncertainty Principle	Natural essence described as a probability cloud.	Measurement limit of a vibrating particle.
Particle Duality	Matter possesses both particle and wave properties simultaneously. Wave collapses upon observation, behaving as a particle.	Matter is a particle; the J-Field reacts to the vibration caused by the particle, generating a wave.
Quantum Entanglement	Unexplainable Non-locality.	0 Seconds via vibration cancellation between two particles.
Quantum Tunneling	Phenomenon of passing through barriers probabilistically.	0 Seconds in the section where particle and barrier vibrations cancel out.
Origin of Universe	Singularity - Spacetime beginning from a singularity.	Cyclic Universe - Beginning from the end of the previous universe.
Dark Energy	Unknown Energy - Expanding the universe.	Result of Waves - Caused by vibrations of matter acting on the J-Field.

Asymmetry of Universe	Left-handedness of Weak Force Matter-Antimatter asymmetry Galaxy rotation alignment Axis of Evil (CMB). Approached as separate, distinct problems.	Cosmic Coriolis Effect - Explains the aforementioned problems through the initial rotation of the early universe.
Entropy	Always increases as a statistical probability; irreversible.	Remains constant due to the inverse correlation between Space (J-Field) and Matter.
Light	Electromagnetic wave; Mass and Time are 0, but possesses velocity and exhibits simultaneous particle/wave nature.	P-wave of J-Field generated by particles; possesses momentum as a pushing force.
Dark Matter	Unknown particle or matter.	Predicted as a neutral particle forming a structure of 16 knots. Possesses a mass of 8.32 MeV.
Arrow of Time	The path from a low entropy state to a high entropy state.	Flow of time due to J-Field expansion and the fall of potential energy. Entropy is the phenomenon of spreading according to that flow

Table (12.1.1)

These perspectives, distinct from existing theories, describe our universe in a more mechanistic manner. This theory holds significance as an attempt to view existing theories through a different lens.

13. The Future Envisioned by Vibrational Cosmology

Thus far, we have explained our universe through the single keyword of "Vibration" and the medium known as the "J-Field."
The future envisioned by this cosmology presents a world distinct from the present. Starting from the simplest phenomenon of vibration, we have examined the entirety of physics supporting our current universe, ranging from Relativity and Quantum Mechanics to Cosmology and various physical mysteries. Now, we intend to explore how this phenomenon of vibration can transform our future.

13.1 Room-Temperature Superconductors

Room-temperature superconductors represent a "dream" in current physics. In Section 7.4.3 of this thesis, we explained the principle of quantum tunneling. This phenomenon occurs when a particle's vibration is cancelled by another vibration, and this principle could enable the design of room-temperature superconductors. If wires are designed with alloys and structures that match the electron's frequency to induce resonance/cancellation, superconductivity will manifest.

13.2 Control of Quantum Tunneling

Quantum tunneling is both a troublesome issue to be solved in the semiconductor field and an indispensable phenomenon in quantum computing. If the principle of quantum tunneling is understood, its control becomes feasible. Utilizing this controllable tunneling phenomenon would allow for exponential advancements in the fields of semiconductors and quantum computing.

13.3 Cold Fusion

If the aforementioned control of quantum tunneling becomes possible, it is highly likely to suggest a new path for cold fusion. By controlling quantum tunneling to penetrate the Coulomb barrier of baryons, nuclear fusion could become feasible even at low temperatures.

13.4 Possibility of Interstellar Travel

Along with room-temperature superconductors, controlled quantum tunneling, and cold fusion, the ultimate goal is humanity's interstellar travel. This corresponds to the Quantum Jump phenomenon explained in Section 6.4.2. If vibration is cancelled to reach a "0-Second State," a "Warp" becomes possible. Within this theory, this is not science fiction but a possibility that could become reality.

If superconductors minimize energy loss, tunneling control enhances computing power, and cold fusion supplies the necessary energy, the technology to cancel the vibration of an entire object—not just particles—approaches as a feasible future.

Of course, this theory remains a hypothesis. However, it implies the potential to explain many things. Personally, I hope this theory is verified, unfolding a more mysterious and exciting future. A school field trip to Andromeda might essentially become a reality.

14. The Universe Viewed Through Vibration

Thus far, using the J-Field and two fundamental axioms, we have examined everything from the era preceding our universe to its beginning and end, ranging from the Theory of Relativity to Quantum Mechanics, Cosmology, and even our future.
The universe viewed through the lens of vibration is colorful and mechanical, yet simultaneously mysterious.

14.1 The Law of Conservation of Existence

In Vibrational Cosmology, a particle—that is, matter—manifests its existence as mass. Furthermore, that existence shares its reality by possessing its own unique time. In other words, to exist is to reveal oneself through one's own mass and time.

Existence is the sum of mass and time.

Let us look at the relational equations describing time and mass in the Theory of Relativity:

$$dt = dt_0 \cdot \, sin\theta$$

$$m = \frac{m_0}{sin\theta}$$

Combining these two equations yields:

$$dt = dt_0 \cdot \frac{m_0}{m}$$

Rearranging both sides, we obtain:

$$m \cdot dt = m_0 \cdot dt_0 = Constant \qquad (14.1.1)$$

This is the ontological formula for existing matter. As a mover acquires velocity and their time slows down, their mass increases proportionally. The product of the mover's mass and time is always equal to the product of the observer's mass and time.
In other words, the total sum proving this existence remains constant whether one is in motion or at rest.

Why does mass become infinite when the time of matter reaching the speed of light becomes zero?

The answer is as follows:

$$\infty \times 0 = Existence \qquad (14.1.2)$$

This finite number indicates that we always exist in the same form.

14.2 Evidence for the Existence of the J-Field (Space)

In this theory, we have explicitly stated that we can neither perceive nor detect the space known as the J-Field. Nevertheless, we have proceeded under the distinct assumption that the J-Field physically exists.

Thus far, this theory has explained that we, and all things in the universe, see, feel, and act through the act of vibration. Therefore, the fact that we can perceive three-dimensional space implies that the J-Field—i.e., Space itself—must also be vibrating. If there were no vibration in space, we would be unable to perceive space itself.

For us to perceive three-dimensional space, space itself is required to vibrate.

Because this space vibrates, we perceive that we are living in the same timeframe, allowing "you and I" to share the same time. Admittedly, this logic may appear speculative. However, this argument represents a personal deduction concluded phenomenologically in observation, epistemologically in perception, and ontologically in existence.

14.3 Let's Save Schrödinger's Cat!

For over a century, Schrödinger's Cat has held the formidable title of being an entity trapped in a box, existing as both dead and alive.

Now, let us attempt to save this poor cat.

A particle entangled with a poison flask and the cat are placed in the same box. According to the Copenhagen interpretation, if the particle is Up-Spin, the cat dies; if it is Down-Spin, the cat lives. The moment we open the box to observe the particle, it is decided then and there whether the cat is dead or alive. Until that moment, the cat is viewed as being in a zombie-like state, simultaneously alive and dead.

Vibrational Cosmology views this similarly, but with one crucial difference. The entangled particle exists in a state where time does not flow. If observed, it will immediately be determined as Up or Down. Consequently, the cat's life or death is determined accordingly.

However, the distinct point here is that until we observe the particle, the cat is simply alive. There is no superposition of the particle. The particle's time has simply not flowed yet. Now, we can simply retrieve the living cat without observing the particle.

15. Conclusion

This theory aims to demonstrate integration by unifying the currently successful theories explaining the universe, particles, and phenomena under the single concept of the J-Field. As a meta-theory encompassing existing theories, it presents reinterpretations and new interpretations of cosmic particles and phenomena based on more fundamental axioms.

This theory represents a shift in perspective, viewing space—previously perceived merely as a background—not as the backdrop of our universe but as its protagonist. In this view, matter is not the main character of our universe; rather, the space known as the J-Field plays that role. The dynamic movement of space can be seen as the foundation that creates time, particles, and furthermore, us.

It attempted to explain the phenomenon of vibration as the origin of time, the universe's greatest mystery. It posits that the concept of time emerges as a product of the phenomenon of vibration.

Of course, this theory is at the hypothesis stage. However, I am convinced that this theory demonstrates an expansion of perspective by viewing existing viewpoints differently.

Although it is a hopeful wish, if the universe based on vibration is correct, the world we live in could advance to another level. Warping via the "0-Second State" caused by vibration cancellation, and designing superconductors through vibration cancellation may become possible. Furthermore, if control of quantum tunneling becomes feasible, it could bring about a revolution in semiconductor design.

I, the author of this theory, am not a physicist. I am a simple office worker who graduated from a 2-year college. I simply wanted to convey my thought that many things can be explained through a shift in thinking. Of course, this theory might be wrong, and to real scientists, it may appear clumsy. I write this simply with the desire to contribute, even if slightly, to the advancement of science by presenting a perspective different from the current one.

The worldview of this Vibrational Cosmology can be summarized as follows:

“이기불상리(理氣不相離), 이기불상잡(理氣不相雜), 기발이승일도(氣發理乘一途)
무극(無極)이 곧 태극(太極)이요, 공즉시색(空卽是色) 색즉시공(色卽是空)이라.”

This implies that the J-Field the principle arising from it ($dt = d\theta/\omega$) are inseparable and behave as a unified entity, yet they are distinct. The J-Field manifests, and the principle generated thereby acts in accordance. Nothingness implies infinity; Space is everything, and everything is Space.

Finally, I would like to express my gratitude and love to my wife and sons.

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