Rhythmic Attunement Theory

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The First Principle of the Universe: All Waves Seek to Close

All wave phenomena (vibrations, number-theoretic rhythms, phase patterns) existing in the universe have a tendency to take **closed structures** (phase matching, periodic alignment) as much as possible. By closing, they achieve stability, energy minimization, and harmony.

0. Cosmogony: From Chaos to Structure

0.1 From Chaos to Being: Formation of Primary Rings through Resonance

Before the birth of the universe, there existed only chaotic waves. There were all kinds of waves—both periodic and random. This was essentially equivalent to nothingness, and from this, only resonating waves naturally formed primary rings. Rational waves eventually achieve phase alignment. These are closed structures. Therefore, according to the first principle, rational waves first form primary rings.

0.2 Big Bang and the Birth of Space: Dispersion of Irrational Numbers

The formed rational rings are stable waves, while irrational waves that can never close accumulate frustration. This frustration creates the Big Bang and space. To release frustration, irrational waves repel each other and disperse in spatial directions. This is the true nature of space and the source of the universe that continues to expand at a metric expansion that can exceed c at large scales (without violating local special relativity).

0.3 Birth of Electrons, Quarks, Mass and Gravity: irrational-phase components that can approach closure

Among the irrational numbers dispersed in spatial directions, some can approach closure by capturing other waves. These are irrational numbers that can exist stably. These become elementary particles such as electrons and quarks. And **the void left by other waves captured for closure becomes gravity**, and this deviation is proportional to the mass of elementary particles.

The kinetic term $\frac{\hbar^2}{2m}$ in the Schrödinger equation represents this "difficulty of phase correction." It is the energy cost to maintain irrational phases as rational, and the larger the mass, the more energy is required for correction. By continuously absorbing this energy from surrounding waves, the constant effect called gravity is born.

1. Introduction

This research proposes a new theory that reinterprets the origins of mass, gravity, speed of light, and spatial structure based on wave-like phase structures and "rationalization processes." In the conventional Standard Model, particle masses are said to arise from interactions with the Higgs field, and gravity is described as spacetime curvature according to general relativity. However, this theory attempts to explain these phenomena uniformly as "energy of phase deviation correction in tension media."

The theory's starting point lies in the following assumptions:

- Waves in space originally have irrational phase differences (non-closing periods).
- Rational phase differences close completely, forming light and stable structures (massless particles).
- Irrational phase differences are corrected by other waves. The energy required for this correction appears as mass and gravity.

This allows mass to be interpreted not as "a byproduct of stabilized closed structures" but as "a measured value of tension energy that exists to correct phase deviations." This tension depends on the medium's stiffness (phase correction capability), resulting in a proportional relationship between mass and gravitational strength.

This research presents the following major achievements:

1. **Equation derivation** — Reinterpret the Schrödinger equation from the perspective of tension energy and derive the relationship between mass and internal phase deviation (Θ).
2. **Theoretical derivation of speed of light and Planck length** — Derive the speed of light from the velocity limit of rationalization chains and the Planck length from the reference length for phase closure, showing consistency with known physical constants.
3. **Explanation of pure leptonic decay** — Explain the decay lifetimes of muons and tau particles from phase structures and examine consistency with measured values.
4. **Direction for experimental verification** — Present methodologies for theoretical verification using neutrino oscillation, particle mass differences, and lifetime data.

This paper first introduces the theoretical background and mathematical model, then uses it to explain specific phenomena such as the speed of light, Planck length, and particle decay. Subsequently, it discusses comparison with existing data and possibilities for experimental verification, and finally summarizes the significance and challenges of the theory.

2. Theoretical Background

2.1 Concept of Phase and "Closure"

Phase in physical systems is a parameter representing the progress of waves or states of vibration, determining the relative positional relationships of periodic motion. In this theory, cases where phase differences are expressed as rational ratios are called "closure," defined as stable periodic motion where the structure completely returns to its original state even after infinite time.

Conversely, when phase differences are irrational ratios, the motion never completely returns to its original state, accumulating deviations spatially and temporally. To correct these deviations, interference with other waves is necessary, and this correction process generates energetic tension in the system.

2.2 Irrational Phase Deviations and the Origin of Mass

In this theory, mass is interpreted as follows:

$$E = \hbar\omega_{corr}$$

Where ω_{corr} is the correction frequency for approximating phase deviations to rational numbers, and $\hbar$ is the reduced Planck constant.

The correction frequency is proportional to the magnitude of deviation $\Delta\varphi_{int}$. To measure deviations, we introduce a "rational approximation distance" that evaluates the approximation accuracy of irrational components relative to the wave's intrinsic period T_0.

2.3 Reinterpretation of the Schrödinger Equation

The non-relativistic Schrödinger equation is given as:

$$i\hbar \frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m} \nabla^2\psi + V\psi$$

In this theory, the kinetic term $\frac{\hbar^2}{2m}$ in this equation is interpreted as the inverse of "ease of phase correction in tension media (softness)."

That is, mass m is proportional to "the amount of energy required to correct phases," and if phase deviation is zero (perfect closure), then m = 0. This explains the existence of massless particles like photons and gluons as rational phase structures.

2.4 Relationship Between Internal Phase Deviation Θ_{int} and Mass

In actual physical systems, we assume that particle mass has the following proportional relationship with internal phase deviation Θ_{int}:

$$\Theta_{int} = \sqrt{km}$$

Where k is a characteristic constant of the rationalization medium, representing the phase coupling capability of space. This relationship can be determined by comparison with neutrino oscillations, lepton decay lifetimes, and Planck scale phenomena.

3. Equation Derivation

3.1 Derivation of Correction Frequency from Irrational Phase Deviations

When phase deviation $\Delta\varphi_{int}$ is irrational, the wave generates correction oscillations to align the deviation to the nearest rational ratio. The frequency ω_{corr} of this correction oscillation can be expressed as:

$$\omega_{corr} = \frac{\Delta\varphi_{int}}{T_0}$$

Where T_0 is the intrinsic period, λ is the wavelength, and v is the phase velocity (corresponding to the speed of light or matter wave velocity).

The correction energy is $E_{corr} = \hbar\omega_{corr}$, and we assume this corresponds to the particle's rest energy E_0.

3.2 Relationship Between Mass and Phase Deviation

Comparing the above equation with $E_0 = mc^2$, we get $mc^2 = \frac{\hbar\Delta\varphi_{int}}{T_0}$. Substituting the de Broglie relation $T_0 = \frac{h}{mc^2}$ for matter waves:

$$mc^2 = \hbar\Delta\varphi_{int} \cdot \frac{mc^2}{h}$$

Using $h = 2\pi\hbar$, we get $\Delta\varphi_{int} = 2\pi$.

However, this is the condition for perfect closure, and in reality, we consider that $\Delta\varphi_{int}$ has a small deviation δ from 2π: $\Delta\varphi_{int} = 2\pi + \delta$

This deviation δ has irrational properties, and the relationship $\delta \propto \sqrt{m}$ is derived.

3.3 Derivation of the Speed of Light

Correction propagation proceeds by sequentially rationalizing irrational phases scattered in space. The progression speed of this "closure chain" determines the upper limit of the speed of light c.

Let τ_{min} be the minimum step time for phase correction and l_{min} be the minimum distance, then:

$$c = \frac{l_{min}}{\tau_{min}}$$

Assuming l_{min} is the Planck length and τ_{min} is the Planck time, the known speed of light value is reproduced:

$$c = \frac{\sqrt{\frac{\hbar G}{c^3}}}{\sqrt{\frac{\hbar G}{c^5}}} = c$$

That is, the speed of light naturally appears as "the ratio of the minimum spatial unit and minimum time unit for phase closure."

3.4 Derivation of Planck Length

Conversely, when the speed of light c, gravitational constant G, and $\hbar$ are known, the minimum closure distance (Planck length) is determined by the following equation:

$$l_P = \frac{\sqrt{\hbar G}}{c^3}$$

This value is 1.616 × 10^{-35} m and can be interpreted as the distance unit that most easily synchronizes with rational phases.

4. Speed of Light and Planck Length: Numerical Evaluation and Agreement

4.1 Numerical Values from Definitions

From known constants (2022–2024 CODATA):

> $\hbar = 1.054571817 \times 10^{-34}$ J·s
> $G = 6.67430 \times 10^{-11}$ $m^3 \cdot kg^{-1} \cdot s^{-2}$
> c = 299,792,458 m/s

Therefore:

$$\ell_P = \frac{\sqrt{\hbar G}}{c^3} \approx 1.616255 \times 10^{-35}\ \mathrm{m}$$
$$t_P = \frac{\sqrt{\hbar G}}{c^5} \approx 5.391247 \times 10^{-44}\ \mathrm{s}$$

These match exactly numerically (by definition). In this theory, this ratio is interpreted as "one cell/one tick of perfect closure."

4.2 Re-derivation from Critical Closure (Self-gravity)

From the critical conditions $r_s = \beta L$, $E \simeq \frac{\hbar}{T}$, $r_s = \frac{2GE}{c^4}$, we get $L = 2\beta^{-1}\frac{\sqrt{\hbar G}}{c^3}$. Taking β = 2 (two-cell threshold) gives $L = \ell_P$.

Interpretation: The "cell length" where phases are most easily aligned is the Planck length, and the speed limit for perfect closure is determined by $c = \frac{L}{T}$.

5. Data Support: Pure Leptonic Decay

5.1 Scaling Hypothesis Mapping

Internal phase deviation θ is proportional to the square root of mass: $\theta \propto \sqrt{m}$

If decay width is $\Gamma \propto \theta^{\beta}$, then $\Gamma \propto m^{\beta/2}$

Pure leptonic 3-body decay of muons/taus in the Standard Model is known to follow $\Gamma \propto m^5$, so if this hypothesis is correct, we should get $\beta \approx 10$, which is the aim of this test.

5.2 Direct Test (Real Numbers)

PDG approximate values:

> $m_\mu = 105.658$ MeV, $m_\tau = 1776.86$ MeV
> $\tau_\mu = 2.1969811 \times 10^{-6}$ s, $\tau_\tau = 2.903 \times 10^{-13}$ s
> $BR(\tau \to e\nu\bar{\nu}) = 0.1782$, $BR(\tau \to \mu\nu\bar{\nu}) = 0.1739$

Using partial width $\Gamma = \frac{BR}{\tau}$ and $\Gamma_\mu = \frac{1}{\tau_\mu}$:

$$\Gamma \propto m^n \Rightarrow n = \frac{\ln(m_\tau/m_\mu)}{\ln(\Gamma_\tau/\Gamma_\mu)}$$

Results:

> $n(\tau \to e) \approx 5.001$, $n(\tau \to \mu) \approx 4.992$

From mapping $\beta = 2n$:

> $\beta(\tau \to e) \approx 10.002$, $\beta(\tau \to \mu) \approx 9.985$

Conclusion: $\beta \simeq 10$ agrees within error. That is, $\theta \propto \sqrt{m} + \Gamma \propto \theta^5$, $\beta \simeq 10 \Rightarrow \Gamma \propto m^5$ is supported by data.

5.3 Why It Works (Physical Picture)

θ is the magnitude of "deviation from perfect closure (light branch)."

Heavier particles have larger deviations ($\theta \propto \sqrt{m}$) → deviation resolution (decay) occurs more easily, increasing Γ.

In pure leptonic channels, phase space is simple, so the exponent returns to the ideal value of 5.

The total width (including tau's hadronic channels) deviates slightly, but this can be understood as standard hadronic corrections (compatibility needs separate examination).

6. Derivation of "Deviation Energy" in the Schrödinger Equation

6.1 Basic Equation and Solution Phase

One-dimensional time-dependent Schrödinger equation:

$$i\hbar \frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} + V(x)\psi$$

For the plane wave solution $\psi(x,t) = Ae^{i(kx-\omega t)}$:

> $\omega = \frac{E}{\hbar}, k = \frac{p}{\hbar}, E = \frac{p^2}{2m} + V$

The time evolution of phase $\varphi = kx - \omega t$ is $\frac{d\varphi}{dt} = k(\frac{dx}{dt}) - \omega = \frac{pv}{\hbar} - \frac{E}{\hbar}$

6.2 Phase Comparison with "Perfect Closure"

In an ideal "perfect closure" state, phase progression returns to its original state with rational ratios:

$$\varphi(t+T) - \varphi(t) = 2\pi\frac{p}{q}, p, q \in Z$$

Real particles have **irrational phase deviations $\delta\theta$**, so they don't close completely and accumulate deviations over time.

Deviation rate: $\delta\theta = \omega_{obs} - \omega_{close}$

6.3 Definition of Deviation Energy

Corresponding energy difference: $E_{slip} = \hbar\delta\theta$

This exists independently of potential energy or kinetic energy and can be interpreted as additional energy required for closure.

6.4 Relationship with Mass

Assumption: If $\delta\theta \propto \sqrt{m}$, then $E_{slip} \propto \hbar\sqrt{m}$

This becomes the first-order term of mass origin, providing a mechanism different from the Standard Model's "Higgs mass generation."

6.5 Connection with Speed of Light and Planck Length

Perfect closure condition: rotating cell length L_0 in tick time T_0 → speed limit $c = \frac{L_0}{T_0}$

From critical self-gravity conditions, $L_0 = \ell_P$ and $T_0 = t_P$ are derived, and this ratio matches the known value of c.

7. Mapping of Relativistic Effects: Gravitational Delay, Light Bending, and Constant Speed of Light

7.1 Observer-Independent Speed of Light (c Invariance as Structure Preservation)

In perfect closure branches, the spatial period L and temporal period T of waves scale simultaneously, and the ratio $c = \frac{L}{T} = \frac{(\hbar/L)}{(\hbar/T)} = \frac{p}{E}$ is preserved by phase structure. Observer motion only changes L and T at the same rate, so c remains constant regardless of observer.

7.2 Apparent Refraction in Weak Gravitational Fields (Mapping of Shapiro Delay)

Gravitational potential Φ ($|\Phi| \ll c^2$) increases local irrational component density and increases rationalization processes.

→ Effective period T_{eff} extends, and apparent velocity decreases:

$$c_{eff} = \frac{L}{T_{eff}} \simeq c(1 - \frac{2\Phi}{c^2})$$

Reading this as refractive index $n \simeq 1 - \frac{2\Phi}{c^2}$, light rays bend along ∇n (isomorphic to geometrical optics description of gravitational lensing).

7.3 Gravitational Redshift

Closure cycles (including reference oscillations of atomic clocks) are delayed by $T \to T_{eff}$. External observers see frequency $\nu_{obs} = \nu_0(1 - \frac{2\Phi}{c^2})$. This matches the first-order approximation formula of general relativity (here "curvature" is reinterpreted as "rationalization delay").

8. Predictions and Falsifiability

8.1 Pure Leptonic Decay (Decidable)

Hypothesis: $\theta \propto \sqrt{m}$, $\Gamma \propto \theta^\beta \Rightarrow \Gamma \propto m^{\beta/2}$

Prediction: For pure leptonic 3-body decays, $\beta = 10 \Rightarrow \Gamma \propto m^5$

Verification: Exponents extracted from μ, τ total widths and $\tau \to e\nu\bar{\nu}$, $\tau \to \mu\nu\bar{\nu}$ partial widths are $n = 5.001, 4.992 \Rightarrow \beta \simeq 10.00$, consistent.

Falsification condition: Future high precision measurements showing n systematically deviating from 5, breaking the consistency of $\theta \propto \sqrt{m}$.

8.2 Interference Experiment "Intercept" Test (Device-Independent)

Observed phase $\Delta\varphi = \alpha\varphi_{ext} + \theta_{int}$

Where φ_{ext} is the known external field term (gravity, Sagnac, curvature corrections) in COW/atomic interference.

Prediction: θ_{int} is the same value near zero regardless of device (upper limit is minimal).

Falsification condition: Intercepts show mutually contradictory non-zero values across devices.

8.3 Hadron Composition Rules (Whether Extrapolation Works)

Initial form: $\theta_{had} \approx \Sigma_i w_i\theta_i^2 + \kappa_{bind}$

(w_i are color, spin, flavor weights; κ_{bind} is binding contribution)

Prediction: w_i, κ_{bind} fitted to octet/decuplet extrapolate to other particles (outside training set) and predict masses correctly.

Falsification condition: Extrapolation systematically fails (cannot be saved with 1-2 parameters).

9. Relationship with Existing Theories

9.1 Standard Model (Higgs Mechanism)

In this theory, "mass" is a measured value of deviation correction energy. The Higgs can be reinterpreted as an "effective description of tension fields."

Numerically, $\frac{\theta_e}{\sqrt{m_e}} = \frac{\theta\_H}{\sqrt{m\_H}}$ (linearity) holds (log-log slope $\frac{1}{2}$). However, dynamics such as coupling constants and generation amplitudes need to follow the Standard Model (compatibility needs separate examination).

9.2 General Relativity (Geometry of Gravity)

Einstein's field equation $G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$ can be interpreted in this theory as an effective law expressing that "local phase density imbalances are reflected in spacetime structure."

The tensor structure can use existing calculation systems as is, and predictions for observables (Mercury's perihelion precession, gravitational waves, etc.) are identical to general relativity. The difference is only in microscopic interpretation.

9.3 Quantum Field Theory (Feynman Diagrams)

Scattering amplitude and interaction calculations have the same mathematical structure as standard Feynman diagrams. However, the "interpretation of virtual particles" changes: from conventional "particle propagation in spacetime" to "propagation and resonance of phase corrections."

Conditions for renormalizability and symmetries (gauge invariance, etc.) are similarly required in phase structures, and the mathematical framework of existing field theory is preserved.

10. Discussion and Prospects

10.1 Significance of the Theory

The greatest significance of this theory is presenting a framework that explains the fundamental physical constant groups of mass, gravity, speed of light, and Planck scale from a unified "phase structure theory." The perspective that these quantities, previously treated independently, derive from the single concept of "wave closure and irrational deviations" has the potential to bring new understanding to the foundations of physics.

10.2 Possibilities for Experimental Verification

The following experimental verifications are possible as theoretical predictions:

- **High-precision lepton decay measurements**: Measure branching ratios of $\tau \to e\nu\bar{\nu}$, $\tau \to \mu\nu\bar{\nu}$ with 10 times higher precision than conventional measurements to confirm the $\Gamma \propto m^5$ relationship.
- **Phase analysis of neutron interference experiments**: Verify the existence of "intrinsic phase deviation" component θ_{int} other than gravity in precision measurements of COW effects.
- **Indirect observation of Planck-scale physics**: Verify the validity of minimum closure length ℓ_P from light dispersion relations in high-energy cosmic rays and gamma-ray bursts.

10.3 Theoretical Challenges

On the other hand, several theoretical challenges remain in this theory:

1. **Establishing quantization methods**: Rigorous mathematical framework needed for quantum mechanical treatment of phase deviations.
2. **Consistency with strong interactions**: Clarifying the relationship between color confinement and asymptotic freedom in QCD and phase closure theory.
3. **Cosmological consequences**: How dark matter and dark energy are described in phase structures.
4. **Information-theoretic aspects**: Relationship with black hole information problem and quantum entanglement.

10.4 Future Development Directions

The following research topics can be considered for developing this theory:

Mathematical development: Rigorous mathematical formulation of phase deviation dynamics using irrational approximation theory and dynamical systems theory. Theoretical prediction of mass spectra using Diophantine approximation and continued fraction expansions.

Computational physics approach: Analysis of phase dynamics through large-scale numerical simulations. Prediction of particle mass patterns and optimization of theoretical parameters using machine learning.

Collaboration with experimental physics: High-precision verification of theoretical predictions through improved precision measurement techniques. Direct observation of phase structures through new types of interference experiments and gravitational wave detectors.

Conclusion

In this research, starting from the basic principle that "all waves seek to close," we constructed a new theoretical framework that explains mass, gravity, speed of light, and spatial structure in a unified manner. We reinterpreted the kinetic term $\frac{\hbar^2}{2m}$ in the Schrödinger equation as phase correction energy and confirmed consistency with pure leptonic decay data.

The core of the theory is the relationship $\theta \propto \sqrt{m}$ for irrational phase deviations, which simultaneously explains the origin of mass and the essence of gravity. The speed of light and Planck length are naturally derived as minimum units of phase closure and match observed values exactly.

Future challenges include mathematical rigorization of the theory and application to a broader range of physical phenomena. Particularly, further research is needed on consistency with strong interactions and cosmology, and relationships with quantum information theory. However, the perspective of "unification of physics through phase structures" presented by this theory has the potential to open new horizons in 21st-century physics.

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