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COD Phase-Equilibrium Standard Model

A Time-Independent Theory of Structural Selection and Mass Generation Based on Complex Quaternionic Spherical Oscillators

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Abstract

Modern particle physics successfully describes elementary particle interactions through quantum field theory and gauge symmetries. However, the origin of stable particle structures and the mechanism of mass generation remain conceptually separated.

This work presents the COD (Complex Oscillator Dynamics) Phase-Equilibrium Standard Model, a time-independent framework unifying structural selection and mass generation through a common phase-equilibrium principle.

The fundamental unit of existence is proposed to be the Complex Quaternionic Spherical Oscillator (CQSO). These oscillators are intrinsically complex-wave structures exhibiting superposition, resonance, diffraction, interference, entanglement, and tunneling. Through recursive phase interactions, they self-organize into oscillator networks and manifolds that collectively constitute space and global phase organization.

The governing condition of the framework is

$\Delta(\Delta\Phi) \to 0$

which represents recursive phase-equilibrium minimization.

Within this framework, photons, electrons, protons, and neutrons are interpreted as recursive phase-equilibrium eigenstructures emerging from self-organized oscillator geometries. Existence and mass are thereby unified within a common phase-equilibrium ontology.

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1. Introduction

One of the deepest questions in modern physics concerns the relationship between existence and creation.

Contemporary theories describe interactions among already-existing particles with extraordinary precision. Yet they do not directly explain why stable structures exist in the first place.

The COD Phase-Equilibrium Standard Model approaches this problem from a different starting point.

The theory does not begin with particles.

Instead, it begins with existence itself.

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The fundamental ontological unit is the Complex Quaternionic Spherical Oscillator (CQSO), a self-coherent recursive oscillatory structure embedded within a global phase field.

The central proposition of the theory is

Existence = Recursive Phase-Equilibrium Selection

Particles are therefore not primary entities but stable manifestations of recursively selected phase-equilibrium geometries.

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2. Ontological Foundation

The basic complex phase structure is

$S = P + iQ$

where

P = Condensation Component

Q = Support Component

The fundamental phase-equilibrium condition is

$P = Q$

corresponding to

$\theta_{eq} = \pi/4$

$\sin(\theta_{eq}) = 1/\sqrt{2}$

The quantities P and Q represent the two primitive degrees of freedom of existence.

The recursive minimization of phase difference is governed by

$\Delta(\Delta\Phi) \rightarrow 0$

This relation serves as the universal solution underlying structure selection, energy distribution, mass generation, and particle formation.

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3. Complex Quaternionic Spherical Oscillator

The CQSO constitutes the minimal self-coherent unit of existence.

A CQSO possesses:

• recursive oscillation

• phase self-coherence

• spherical closure

• quaternionic organization

• energy conservation through phase equilibrium

The oscillator develops through the intrinsic properties of complex-wave media, including:

• superposition

• resonance

• diffraction

• interference

• entanglement

• tunneling

These properties enable robust yet flexible geometric organization across multiple scales.

A complete individual CQSO forms part of a complete whole.

The Global Bosonic Field is interpreted as the collective ensemble of CQSO existence:

$M\_T = \Sigma$ CQSO

Thus the Global Bosonic Field is not an external background but the totality of recursive CQSO organization.

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4. Phase-Equilibrium Eigenvalue Hierarchy

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The COD framework introduces a hierarchy of eigenvalues governing existence and structure formation.

Fundamental existence degrees of freedom:

$\lambda_P = 1$

$\lambda_Q = 1$

Universal equilibrium:

$\theta_{eq} = \pi/4$

$\lambda_{EQ} = 1/\sqrt{2}$

Internal three-axis equilibrium:

$\gamma_e = \sqrt{3}/2$

Self-reference channel:

$\sigma_{self} = 1$

Available phase freedom:

$\beta_e = (48 - \sigma_{self})/48 = 47/48$

Distributed phase-equilibrium strength:

$\Omega_{SD} = \gamma_e \cdot \beta_e$

These eigenvalues determine the admissible geometry of recursive phase-equilibrium structures.

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5. Structural Selection

Structural selection describes how existence determines which geometries are allowed.

The minimum recursive structural scale is

$\Lambda = (3 \times 4) - 1 = 11$

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The distributed self-closure coefficient is

$B = 1 + \Omega\_SD/8$

The neutral completion coefficient is

$\varepsilon = (81/32)/\Lambda^3$

These quantities are interpreted as geometric closure conditions rather than empirical fitting parameters.

Structural selection determines the existence of admissible particle geometries before mass realization occurs.

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6. Particle Structure Hierarchy

Particles are classified according to their phase-equilibrium closure order.

Photon:

$N = 2$

Phase-support structure without condensation.

Electron:

$M\_e = 1$

Minimum self-coherent condensation structure satisfying

$P = Q$

$\theta\_eq = \pi/4$

Proton:

$G\_P = 3 + 3\Lambda^2 + B\Lambda^3$

Recursive triplet condensation structure.

Neutron:

$G\_N = 3 + 3\Lambda^2 + B\Lambda^3 + \varepsilon\Lambda^3$

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Neutral recursive completion structure.

The particle hierarchy becomes

Photon

↓

Electron

↓

Proton

↓

Neutron

corresponding to increasing levels of recursive phase closure.

Figure 1. Comparison between the Standard Model and the COD Phase-Equilibrium Framework. In COD, mass and stable existence emerge from recursive phase equilibrium geometry between bosonic phase support elasticity (Q) and local condensation (P), rather than from predefined particle parameters.

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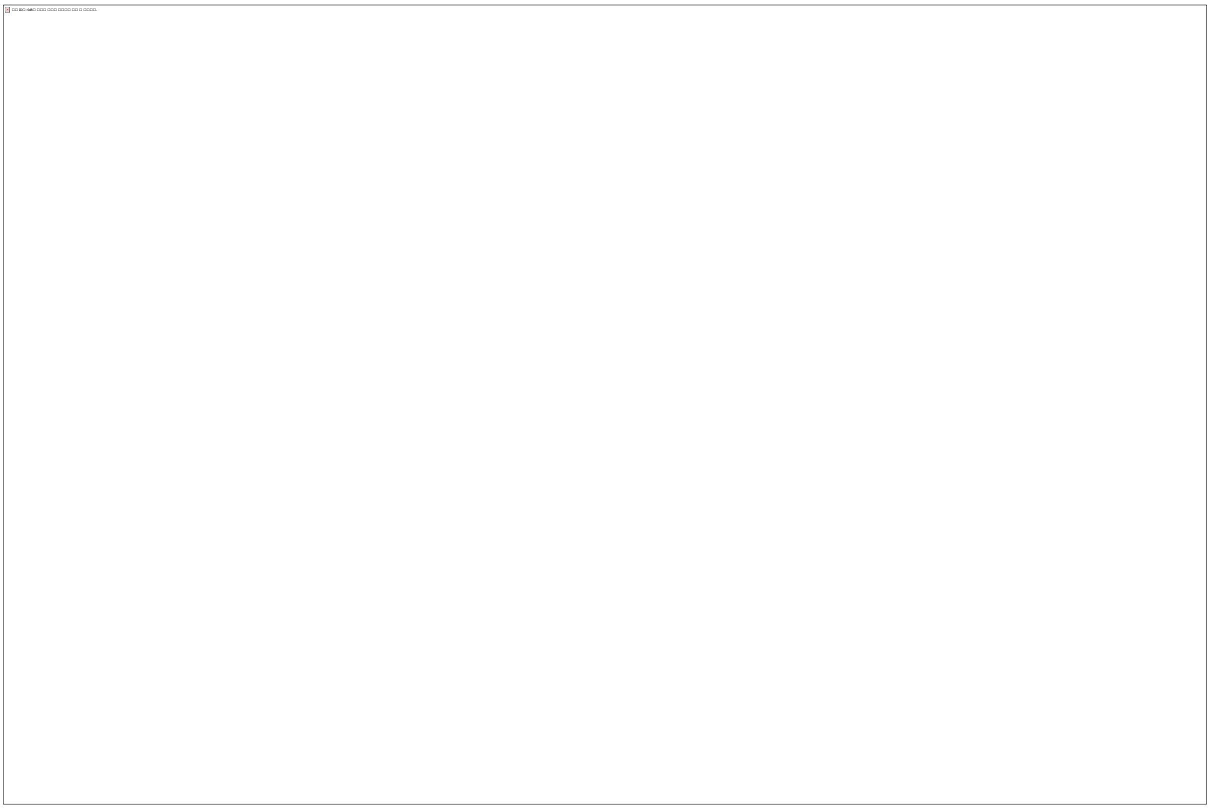

7. Mass Generation

The phase field is represented by

$$\Psi(r) = A(r)e^{(i\Phi(r))}$$

with phase gradient

$$k = |\nabla\Phi|$$

The COD hierarchy is

$k^1 \rightarrow$ Phase Alignment

$k^2 \rightarrow$ Energy Support

$k^3 \rightarrow$ Mass Condensation

Therefore

$$E \propto |\nabla\Phi|^2$$

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$$M \propto \int |\nabla\Phi|^3 \, dV$$

Mass is interpreted as localized self-coherent phase condensation within the Global Bosonic Field.

Structural selection answers:
"What can exist?"

Mass generation answers:
"How does selected existence become physically realized?"

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8. Summary of Results

Particle	Structural Interpretation	Geometric Structure
Photon	Phase-support mode	$N = 2$
Electron	Minimum self-coherent condensation	$M_e = 1$
Proton	Recursive triplet condensation	$M_e (3 + 3\Lambda^2 + B\Lambda^3)$
Neutron	Neutral recursive completion	$M_e (3 + 3\Lambda^2 + B\Lambda^3 + \varepsilon\Lambda^3)$

Compared to experimental values:

Structure eigenvalue residual: +0.105%
Mass Generation residual: ≈ −0.042%

Detailed derivations are provided in the Supplementary Notes (I-p9, II-p20)

9. Discussion

The COD framework unifies ontology and particle formation.

Existence is not assumed.

Existence is selected.

Mass is not inserted as a parameter.

Mass is realized through recursive phase condensation.

The theory therefore establishes the sequence

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Existence

↓

Structural Selection

↓

Mass Generation

↓

Particle Formation

↓

Matter

↓

Universe

Within this framework, structure selection and mass generation become complementary descriptions of a single phase-equilibrium geometry.

10. Conclusion

A time-independent COD Phase-Equilibrium Standard Model has been presented based on Complex Quaternionic Spherical Oscillators.

The theory identifies recursive phase equilibrium as the fundamental principle governing existence, structure selection, mass generation, and particle formation.

The universal governing relation is

$\Delta(\Delta\Phi) \rightarrow 0$

The principal conclusions are:

Existence = Recursive Phase-Equilibrium Selection

Mass = Realized Phase Condensation

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Global Bosonic Field = Collective CQSO Existence

A complete individual forms a complete whole.

The COD framework therefore provides a unified ontological and structural interpretation of matter, particles, and cosmological organization based on recursive phase-equilibrium geometry.

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