ΦBSU – Buoyant Separverse Unification

Field Theory, Part III

Particle Interiors from the Alpha Vacuum

Chapter 1

From fine-structure permeability to leptonic phase-locks

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working manuscript draft, May 2026

Abstract

This chapter develops the opening step of ΦBSU Part III: the transition from the alpha vacuum to elementary leptonic particle interiors. The fine-structure constant is read as a neighborhood-permeability of the vacuum identity structure rather than as a merely external electromagnetic coupling. The inverse value near 137.036 is interpreted as an asymptotic retention number of the nearly non-manifest zero-state, while $125 = 5^3$ is interpreted as the full information-density limit of the first three-rotational internal granulation. Between these two limits the vacuum supports topological density currents, null-fibre phase impulses, and coherence-filtered loops. Leptons are then modelled as closed, Pauli-separated, antipodally coherent phase-locks in the measurable P_+^H branch. Their masses arise as the minimum cost of maintaining closed phase-separation in the alpha-vacuum compliance network. The charged-lepton hierarchy is organized as a $1R, 2R, 3R$ sequence, and the Koide relation appears as the C_3 balance between sameness-amplitude and separateness-amplitude. The primitive Koide seam weight is identified with the $1D \to 2D$ mirror-surface interaction factor $2^1/3^2$: when this factor acts on the 3^2 phase surface, the original antipodal phase content 2^1 is preserved exactly. This factor is complementary to the fine-structure $2D \to 3D$ surface-volume term $(1/2^1)3^2/5^3$. The small deviation from the zeroth-order Koide pattern is interpreted as the first sign that topological loop closure has entered dimensional interaction geometry, where the primitive circumference-diameter relation evolves from 1 toward π.

Contents

1 Aim of Part III

Part I introduced the basic ΦBSU field dictionary: a global phase

$$\Phi = e^{i\alpha}, \tag{1}$$

a separation of local curvature from global identity,

$$A = A_{\text{geom}} + A_{\text{id}}, \qquad A_{\text{id}} = d\alpha, \qquad F_{\text{geom}} = dA_{\text{geom}}, \tag{2}$$

and an invariant vacuum density with a buoyancy field,

$$\rho = \|\nabla\alpha\|, \qquad a_\mu = -\partial_\mu \ln \rho. \tag{3}$$

The point of this dictionary is that local radiation and force are carried by the curvature sector F_{geom}, while global identity and phase memory can remain in A_{id} as holonomy even when local curvature vanishes along a path [1].

Part II used the same idea at cosmic and galactic scales. Sourcewise support, drag-latched memory, and the frozen hierarchy were described as coherence-filtered projections of the same vacuum-memory structure, not as separate dark ontologies [3, 4]. Part III now moves the same programme to the microscopic level.

The central question is:

> **Guiding question**
>
> When does a vacuum phase difference stop being a transient fluctuation and become a particle interior?

The answer pursued here is:

$$\boxed{\text{A particle is a closed, Pauli-separated, antipodally coherent phase-separation interior.}} \tag{4}$$

Charged leptons are the first test case. They carry electric charge, they are spinorial, they are not confined like quarks, and their three known masses display the empirical Koide structure. Therefore the lepton sector is the most economical place to test whether ΦBSU can turn the alpha-vacuum idea into a quantitative particle-interior theory.

The word *alpha vacuum* is used here in the programme-specific sense: it denotes the vacuum state defined by the phase chart α and its neighborhood permeability α_Φ. It is not a reference to the conventional family of de Sitter alpha-vacua.

2 Reader's dictionary

The main symbols used in this chapter are collected in Table 1. The purpose of the table is to prevent the algebra from hiding the physical picture.

Table 1: Working dictionary for Chapter 1.

Symbol	Meaning
α	Phase chart of the global field $\Phi = e^{i\alpha}$.
$A_{\text{id}} = d\alpha$	Identity/holonomy channel. It can carry loop phase data without being local radiation.
$F_{\text{geom}} = dA_{\text{geom}}$	Local curvature channel: forces, radiation, and Poynting energy flux.
$\rho = \|\nabla\alpha\|$	Invariant vacuum density.
$\chi = \ln(\rho/\rho_\infty)$	Operational logarithmic density field used in the macroscopic support and focusing language.
$\varepsilon_\varnothing = 137.036$	Asymptotic identity-retention number of the nearly non-manifest zero-state.
$\varepsilon_E = 125 = 5^3$	Full information-density / energy-presentation limit of the first $3R$ granulation.
$\varepsilon_\Phi(\mathcal{I})$	Local identity-retention function interpolating between 137.036 and 125.
$\alpha_\Phi = \varepsilon_\Phi^{-1}$	Local neighborhood permeability of identity into adjacent states.
$\mathcal{R}_H$	Hypersymmetry Real/mirror-sheet operator. It selects the physical branch through P_+^H.
$\mathcal{A}_K$	Internal Klein-antipode operator inside $K^2 \subset 3R$. It is not the same as $\mathcal{R}_H$.
$P_+^H = (1 + \mathcal{R}_H)/2$	Measurable hypersymmetry-branch projector.
$P_S^K = (1 + \mathcal{A}_K)/2$	Internal symmetric endpoint/comparator projector.
$P_T^K = (1 - \mathcal{A}_K)/2$	Internal antipodal twist projector.
Γ_ℓ	Leptonic internal closure class.
$\mathcal{C}_\ell$	Compliance of a leptonic closure: its ability to distribute phase separation.
$q_\ell = \sqrt{m_\ell/m_*}$	Dimensionless lepton mass-amplitude.

A crucial distinction is

$$\mathcal{R}_H \neq \mathcal{A}_K. \tag{5}$$

The operator $\mathcal{R}_H$ is the hypersymmetry mirror-sheet operator used to define the measurable branch,

$$P_+^H = \frac{1}{2}(1 + \mathcal{R}_H), \tag{6}$$

whereas $\mathcal{A}_K$ is the internal Klein-antipode acting inside the $K^2 \subset 3R$ phase surface. If the two were identified, the internal seam term would disappear in the physical branch, since

$$P_+^H(1 - \mathcal{R}_H)P_+^H = 0. \tag{7}$$

The mass-generating internal seam must instead be built from $\mathcal{A}_K$:

$$P_+^H(1 - \mathcal{A}_K)P_+^H \neq 0 \tag{8}$$

in general. This is consistent with the hypersymmetry projection stance: the operational $M^4 \times K^2$ chart is a measurable representation of a deeper $3T \times 3R$ base, and direct observations select coherent spin-1 composites without adding new on-shell mirror poles [2].

3 Fine structure as vacuum permeability

In ordinary QED language, the fine-structure constant α is the dimensionless strength of electromagnetic interaction. In the present ΦBSU reading, its deeper role is the minimal permeability by which an identity difference in the vacuum becomes visible to neighboring states. The observed inverse fine-structure constant is 137.035999177(21) in the CODATA 2022 adjustment [6]. This chapter uses the rounded structural value

$$\varepsilon_\varnothing = 137.036 \tag{9}$$

as the first alpha-vacuum retention limit.

The information-theoretic motivation is simple. If two states are completely identical and no phase, holonomy, comparator state, or projection difference distinguishes them, then counting them as two events adds no information. Complete sameness is therefore not a duplicated existence. It is the absence of separative information.

A physical event begins only when the zero-state fails to remain perfectly hidden. It must leak into its neighborhood just enough to become distinguishable:

$$\boxed{\alpha_\Phi(0) = \varepsilon_\varnothing^{-1} \simeq \frac{1}{137.036}.} \tag{10}$$

Here $\varepsilon_\varnothing$ is not the SI vacuum permittivity, and it is not a universal energy stiffness. It is a dimensionless identity-retention number: the asymptotic resistance of the nearly non-manifest zero-state against becoming a separative event.

4 The structural count behind 137.036 and 125

The structural count used in this chapter is

$$\varepsilon_\varnothing = 1 + 2 + 3^2 + 5^3 + \frac{1}{2}\frac{9}{125} = 137.036. \tag{11}$$

The count should not be read as a detached numerical coincidence. In the $3T \times 3R$ projection stance, it is the first allowed closure-count of the internal $3R$ sector: identity, antipodal distinction, surface separation, and three-rotational volume granulation.

The terms are interpreted as follows.

Term	Topological role
1	Identity bit: the still undivided same.
2	First antipodal distinction: a minimal mirror relation between self and other.
3^2	First non-equal-phase surface lattice: a two-directional phase surface in the internal rotational sector.
5^3	First full three-rotational granulation: a $5 \times 5 \times 5$ internal volume count.
$\frac{1}{2}\frac{9}{125}$	Antipodally halved surface-to-volume permeability, from the 3^2 surface into the 5^3 volume.

The numbers 3 and 5 have a specific role in this model. The guiding rule is that a genuinely new conformal-ontic level must be generated by a cycle count that is independent of the divisibility of the previous levels. A composite count would already factor through an older closure and would therefore mix with an existing structural share instead of adding a new degree of separative freedom. In the background-independent setting, such mixing is not a harmless coordinate redundancy: if the new cycle is divisible by an older cycle, its phase returns through the older comparator and fails to define an independent structural addition. Hence the first admissible cycle counts beyond identity are prime counts.

Equivalently, only a prime number of causal-separation cycles can stand as the new structural count of a conformal-ontic level. The new level is an independent share of the total closure, not a refinement of an older share. If its cycle number were composite, part of the new phase period would be readable through a previous divisor, and the supposed new level would not add a clean causal separability class. This is the arithmetic reason for using the prime sequence $2, 3, 5$ as the first independent cycle counts of the internal $3R$ sector.

The binary count 2^1 supplies the one-dimensional antipodal mirror-ring: it is the first causal separation between self and other. The next independent level cannot use another factor of 2, because that would only replay the mirror split; the first new prime is 3, and its two-dimensional surface count is 3^2. The full internal volume then requires a third independent conformal-ontic direction. The next independent prime after 2 and 3 is 5, giving the three-rotational saturation count 5^3. Thus the dimensional bookkeeping is not $1+2+9+125$ as ordinary spatial dimensions; rather, the structural levels are the one-dimensional mirror ring, the two-dimensional phase surface, and the three-dimensional internal volume:

$$1D + 2D + 3D = 6D, \tag{12}$$

with operational $M^4 \times K^2$ appearing as a measurable chart of this deeper $3T \times 3R$ closure. In this reading, 5^3 is not an arbitrary base. It is the first saturated three-rotational information-density volume that can follow the identity, antipode, and surface stages without being a composite replay of them.

The second asymptote is therefore

$$\boxed{\varepsilon_E = 125 = 5^3.} \tag{13}$$

It is not a second approximation to the fine-structure constant. It is the full information-density limit: the point at which identity difference is no longer mostly retained as a zero-state, but is forced to present itself as energy-bearing structure.

The alpha-vacuum compliance function is written

$$\boxed{\varepsilon_\Phi(\mathcal{I}) = \varepsilon_\varnothing - (\varepsilon_\varnothing - \varepsilon_E) S(\mathcal{I}),} \tag{14}$$

with

$$0 \le \mathcal{I} \le 1, \qquad S(0) = 0, \qquad S(1) = 1. \tag{15}$$

Thus

$$\varepsilon_\Phi(0) = 137.036, \qquad \varepsilon_\Phi(1) = 125, \tag{16}$$

and

$$\boxed{\alpha_\Phi(\mathcal{I}) = \varepsilon_\Phi(\mathcal{I})^{-1}.} \tag{17}$$

This is not the ordinary QED running of $\alpha(q^2)$. QED running belongs to the operational electromagnetic chart. The function $\varepsilon_\Phi(\mathcal{I})$ is an internal identity-compliance function: it measures how much separative phase can be retained as a near-zero state and how much must appear as energy-bearing information density.

5 Topological density currents in the fluctuation plasma

The early fluctuation plasma in this chapter is not a soup of pre-existing particles. It is a field of possible phase differences, null-fibre impulses, antipodal parity changes, and holonomy classes. Most of these do not survive. They are randomized before they close into a persistent comparator.

A particle interior appears only when a phase-separation class satisfies four conditions:

(i) it closes;

(ii) it is antipodally coherent;

(iii) it is Pauli-separated from identical closures;

(iv) it survives the physical P_+^H projection.

To express this without assuming a pre-existing background space, let

$$\mathfrak{G}_\Phi = \{\omega : \omega \text{ is an allowed holonomy/parity class}\} \tag{18}$$

be the graph of allowed topological transitions. If $n_\omega(\eta)$ is the coarse-grained density of class ω at causal ordering stage η, then a topological density current is

$$\mathcal{J}_\omega = n_\omega v_\omega, \tag{19}$$

and its continuity equation is

$$\boxed{\partial_\eta n_\omega + \nabla_{\mathfrak{G}} \cdot \mathcal{J}_\omega = \mathcal{S}_\omega - \mathcal{D}_\omega.} \tag{20}$$

Here $\mathcal{S}_\omega$ creates new closure possibilities and $\mathcal{D}_\omega$ removes decohered or sameness-collapsed classes. A stable particle-interior candidate is a class for which, locally,

$$\partial_\eta n_\omega \simeq 0, \qquad \nabla_{\mathfrak{G}} \cdot \mathcal{J}_\omega \simeq 0. \tag{21}$$

This means that the structure is no longer just a plasma fluctuation. It has become a recurrent topological current.

In an operational chart this can be represented by a null-fibre current along a closure class Γ:

$$j_\Gamma^\mu(x) = \int_\Gamma d\lambda_\Phi \, n_\Gamma(\lambda_\Phi) k^\mu(\lambda_\Phi) \delta_\Phi\big(x - X_\Gamma(\lambda_\Phi)\big). \tag{22}$$

For a coherent closed interior,

$$\nabla_\mu j_\Gamma^\mu \simeq 0. \tag{23}$$

The non-orientable holomorphic notes give a natural geometric picture for this stage: antipodal double covering, a Klein-bottle phase surface, twisting light cones, and null-geodesic fibres form a setting in which opposite-taste primordial waves can cancel in the vacuum state while phase shifts become observable only through projection and closure [5].

6 Pauli separation as the first existence rule

The Pauli principle is usually introduced as a property of identical fermions: two identical fermions cannot occupy the same quantum state. Here it is read one step deeper. If two would-be excitations are completely identical in the same projection branch and in the same holonomy class, they do not represent two information events.

The separability condition can be written as

$$\boxed{d_{\mathrm{FS}}([\Psi_i],[\Psi_j]) + d_{\mathrm{hol}}(\Gamma_i,\Gamma_j) \geq \delta_P.} \tag{24}$$

Here d_{FS} is the projective Hilbert-space distance, d_{hol} is holonomy-class distance, and δ_P is the Planck-scale separability threshold. If

$$[\Psi_i] = [\Psi_j], \qquad [\Gamma_i] = [\Gamma_j], \tag{25}$$

then the second excitation adds no new separative information. It is not a second event.

Thus Pauli exclusion becomes an existence rule:

$$\boxed{\text{complete sameness in one branch is not duplicated existence.}} \tag{26}$$

The familiar fermionic antisymmetry is the operational quantum-chart form of this deeper separation rule.

7 Symmetric endpoint impulses and coherent photon twists

The photon vocabulary must be precise because leptons will be built as closed phase-locks involving the same internal channels. Define the symmetric and twist projectors of the internal Klein antipode:

$$P_S^K = \frac{1}{2}(1+\mathcal{A}_K), \qquad P_T^K = \frac{1}{2}(1-\mathcal{A}_K). \tag{27}$$

The symmetric endpoint channel is

$$\boxed{h_{1/2\gamma} = P_+^H P_S^K h.} \tag{28}$$

This is the object previously called a half-photon state. It is not half of a photon energy. It is a symmetric null-fibre phase impulse that can mediate an endpoint or comparator boundary condition. It may appear as electric pressure or as the absence of such pressure at charge interfaces, but it is not a free radiation quantum and it must not generate a new asymptotic pole.

The full photon channel is

$$\boxed{h_\gamma = P_+^H \mathcal{C}_{\mathrm{spin1}}(P_T^K h).} \tag{29}$$

The internal twist $P_T^K h$ is antipodally nontrivial. It becomes an observable photon only as a coherent spin-1 projection. The local radiative energy belongs to F_{geom}, while A_{id} keeps the identity/holonomy bookkeeping. This preserves the hypersymmetry stance: coherent spin-1 composites are directly measurable, while other null-fibre excitations appear mainly through holonomy, focusing, caustics, and effective actions [2].

At the topological level the twist is not primarily a π angle. It is

$$\mathcal{A}_K h = -h \tag{30}$$

or

$$\Phi \mapsto -\Phi. \tag{31}$$

Only after choosing the $U(1)$ chart $\Phi = e^{i\alpha}$ can the same statement be written as

$$e^{i\Delta\alpha} = -1, \qquad \Delta\alpha = \pi \pmod{2\pi}. \tag{32}$$

The number π is therefore not a primary topological input. It is the metric chart expression of antipodal closure.

8 Leptonic closure

A charged lepton is defined as the first stable particle interior in which the symmetric endpoint channel and the antipodal twist channel lock into one spinorial closure:

$$\boxed{\ell^{\pm} = P_{+}^{H}\,\mathrm{Lock}\big(P_{S}^{K}h, P_{T}^{K}h, \Gamma_{\ell}\big).} \tag{33}$$

The spinorial double cover is written topologically as

$$\boxed{\Psi_{\ell}(\gamma) = -\Psi_{\ell}, \qquad \Psi_{\ell}(\gamma^2) = \Psi_{\ell}.} \tag{34}$$

Here γ is the nontrivial closure generator. Only in a metric circle chart does this become the familiar $2\pi/4\pi$ spinor condition.

The charge is read as a holonomy orientation. In a $U(1)$ chart one may write

$$Q_{\ell} = \frac{1}{2\pi}\oint_{\Gamma_{\ell}} d\theta_{Q} = \pm 1, \tag{35}$$

but the primary statement is not the numerical 2π denominator. The primary statement is that the closure carries a nontrivial charge orientation and remains measurable in the P_{+}^{H} branch.

Leptogenesis, in the first Part III sense, means the emergence of these stable leptonic interiors from the alpha-vacuum fluctuation plasma. It is not yet the full cosmological lepton-number problem. The first target is the interior mechanism: how a charged spinorial closure acquires a mass and why there are three charged-lepton generations.

9 Mass as the cost of closed phase separation

Let Γ_{ℓ} be the internal closure class of a lepton. On this closure we use not an assumed Euclidean length ds, but a topological-compliance measure $d\lambda_{\Phi}$. The internal phase-lock field is θ_{ℓ}. The first gradient-cost functional is

$$\boxed{E_{\mathrm{grad}}[\theta_{\ell}] = \frac{\kappa_{\Phi}}{2}\int_{\Gamma_{\ell}} \varepsilon_{\Phi}(\mathcal{I})\left(\frac{D\theta_{\ell}}{d\lambda_{\Phi}}\right)^{2} d\lambda_{\Phi}.} \tag{36}$$

The constant κ_{Φ} is the phase stiffness of the alpha-vacuum. In the macroscopic Part II chart the same stiffness appears as vacuum support and focusing through the logarithmic density field $\chi = \ln(\rho/\rho_{\infty})$ and its sourcewise hierarchy. Thus κ_{Φ} is not introduced as an unrelated lepton-scale parameter; it is the microscopic stiffness whose large-scale projection becomes the ρ/χ support language [3, 4].

The holonomy constraint is

$$\int_{\Gamma_{\ell}} D\theta_{\ell} = \Theta_{\ell}. \tag{37}$$

Variation gives

$$\frac{D\theta_\ell}{d\lambda_\Phi} = \frac{\Theta_\ell}{\mathcal{C}_\ell\, \varepsilon_\Phi(\mathcal{I})}, \tag{38}$$

where

$$\boxed{\mathcal{C}_\ell = \int_{\Gamma_\ell} \frac{d\lambda_\Phi}{\varepsilon_\Phi(\mathcal{I})}} \tag{39}$$

is the compliance of the closure. It measures how well the internal loop can distribute its phase separation.

The minimized gradient energy is therefore

$$\boxed{E_{\text{grad}}^{\text{min}} = \frac{\kappa_\Phi}{2}\frac{\Theta_\ell^2}{\mathcal{C}_\ell}.} \tag{40}$$

The full lepton mass-energy is modelled as

$$\boxed{m_\ell c^2 = \frac{\kappa_\Phi}{2}\frac{\Theta_\ell^2}{\mathcal{C}_\ell} + E_{\text{seam},\ell} + E_{\text{curv},\ell} + E_{\text{occ},\ell}.} \tag{41}$$

The correction terms have distinct roles:

$$E_{\text{seam},\ell} = \text{internal Klein-antipode seam locking energy}, \tag{42}$$
$$E_{\text{curv},\ell} = \text{focusing, curvature, and self-interaction correction}, \tag{43}$$
$$E_{\text{occ},\ell} = \text{occupancy cost associated with the } 125 = 5^3 \text{ information-density limit.} \tag{44}$$

The central mass statement is

$$\boxed{\text{mass is the minimum cost of closed phase separation in alpha-vacuum compliance.}} \tag{45}$$

10 The $1R, 2R, 3R$ ordering of charged leptons

Let the three internal rotational-compliance directions be

$$\mathcal{R}_1, \mathcal{R}_2, \mathcal{R}_3. \tag{46}$$

They are not the hypersymmetry operator $\mathcal{R}_H$. They are the three internal $3R$ repetition channels of the primary phase base.

The first charged-lepton ordering is

$$\boxed{\tau = 1R, \qquad \mu = 2R, \qquad e = 3R.} \tag{47}$$

This means

$$\Gamma_\tau \subset \mathcal{R}_1, \tag{48}$$
$$\Gamma_\mu \subset \mathcal{R}_1 \oplus \mathcal{R}_2, \tag{49}$$
$$\Gamma_e \subset \mathcal{R}_1 \oplus \mathcal{R}_2 \oplus \mathcal{R}_3. \tag{50}$$

The number of active R channels is not an external generation label. It is read as a cycle-distance on the two-dimensional 3^2 phase surface. A one-step surface distance activates one conformal looping cycle; a two-step distance activates two; and the third step already reaches the common causal node of the $3R$ surface. At that point all conformal looping cycles available to a single charged spinorial closure are in use.

Thus the tau closure is topologically simplest but energetically heaviest: it maintains the antipodal phase shift on one active cycle. The muon shares the same kind of antipodal coherence over two active cycles. The electron reaches the common causal node and uses all three $3R$ looping cycles. Its coherent antipodal-pair phase shift is therefore distributed over the full internal compliance network, making it the lightest stable ageing, or ticking, charged lepton.

In a coarse compliance notation this reads

$$N_R(\tau, \mu, e) = (1, 2, 3), \qquad D\theta_a \sim \Theta_\ell / N_R. \tag{51}$$

The third case is special: it is not merely "one more" channel, but the closure in which the two-dimensional cycle-distance has reached its common causal node and the antipodal phase can be shared across every conformal loop of the charged-lepton interior. Hence the compliance ordering is

$$\mathcal{C}_\tau < \mathcal{C}_\mu < \mathcal{C}_e, \tag{52}$$

and the corresponding qualitative hierarchy is

$$m_\tau > m_\mu > m_e. \tag{53}$$

This is a conceptual inversion of the usual intuitive picture:

> the electron is light not because it is structureless, but because it is the most fully distributed $3R$ closure.

11 Koide structure from the C_3 seam

Because the energy functional is quadratic in phase gradients, the natural first spectral variable is the mass-amplitude

$$q_\ell = \sqrt{m_\ell / m_*}, \tag{54}$$

not the mass itself.

Let C_3 be the cyclic operator of the three internal R channels:

$$C_3^3 = 1. \tag{55}$$

In a complex chart its characters can be written as $\omega^3 = 1$, but the topological input is only the cyclic closure.

The reduced $3R/K^2$ mass-amplitude operator is proposed as

$$\boxed{\mathfrak{Q}_{3R/K} = q_0 \left[I + \frac{1}{\sqrt{2}} \left(\xi_K C_3 + \xi_K^{-1} C_3^{-1} \right) \right].} \tag{56}$$

Its eigenvalues are

$$\boxed{q_n = q_0 \left[1 + \sqrt{2}\, \Re(\xi_K \omega^n) \right], \qquad n = 0, 1, 2.} \tag{57}$$

Here

$$\xi_K = e^{i\vartheta_K} \tag{58}$$

is the chart representation of the $3R/K^2$ seam generator. The zeroth-order topological candidate is

$$\boxed{\vartheta_K^{(0)} = -\frac{2}{9} = -\frac{2^1}{3^2}.} \tag{59}$$

The origin of this weight is the same dimensional-compliance logic that produced the fine-structure correction term, but it acts one interface earlier. The fine-structure permeability term

$$\delta_\alpha = \frac{1}{2^1}\frac{3^2}{5^3} \tag{60}$$

measures an antipodally halved leakage from the two-dimensional 3^2 phase surface into the three-dimensional 5^3 internal volume. The Koide seam generator instead belongs to the preceding $1D \to 2D$ contact: the one-dimensional antipodal mirror-ring has information content 2^1, while the two-dimensional phase surface has information content 3^2.

The generator is therefore the interaction factor which lets the $2D$ surface carry the $1D$ antipodal phase without diluting or multiplying it. Acting on the full 3^2 surface, it preserves the antipodal content exactly:

$$\left(\frac{2^1}{3^2}\right) 3^2 = 2^1. \tag{61}$$

Hence

$$\left|\vartheta_K^{(0)}\right| = \frac{2^1}{3^2}. \tag{62}$$

The minus sign in $\vartheta_K^{(0)} = -2/9$ records the seam orientation: the generator is an antipodal twist weight, not a positive population fraction.

Thus the Koide generator is not introduced as an ad hoc trigonometric parameter. It is the exact $1D \to 2D$ seam factor by which the 3^2 phase surface can host a 2^1 antipodal phase pair while keeping that pair invariant. This complements δ_α, the corresponding $2D \to 3D$ surface-volume permeability. The two ratios form a useful multiplicative bridge,

$$\frac{2^1}{3^2} \cdot \frac{1}{2^1}\frac{3^2}{5^3} = \frac{1}{5^3}, \tag{63}$$

showing that the mirror-to-surface seam and the surface-to-volume leakage compose to the full information-density permeability $1/125$.

This is not a fraction of a full 2π turn. It is a primitive seam interaction weight. The 2π appears only after the C_3 structure is represented in a metric complex chart.

The Koide relation follows directly. Let

$$x_n = \Re(\xi_K \omega^n). \tag{64}$$

For the three C_3 characters,

$$\sum_{n=0}^{2} x_n = 0, \qquad \sum_{n=0}^{2} x_n^2 = \frac{3}{2}. \tag{65}$$

Therefore

$$\sum_n q_n = 3q_0, \tag{66}$$

and

$$\sum_n q_n^2 = q_0^2 \left(3 + 2\sum_n x_n^2\right) = 6q_0^2. \tag{67}$$

Since $m_n = m_* q_n^2$,

$$\boxed{\frac{m_0 + m_1 + m_2}{\left(\sqrt{m_0} + \sqrt{m_1} + \sqrt{m_2}\right)^2} = \frac{2}{3}.} \tag{68}$$

In vector form,

$$\mathbf{q} = \mathbf{q}_{\parallel} + \mathbf{q}_{\perp}, \tag{69}$$

where

$$\mathbf{q}_{\parallel} \parallel (1,1,1), \qquad \mathbf{q}_{\perp} \perp (1,1,1), \tag{70}$$

and Koide is

$$\boxed{\|\mathbf{q}_{\parallel}\| = \|\mathbf{q}_{\perp}\|.} \tag{71}$$

The information-theoretic reading is immediate:

$$\boxed{\text{sameness-amplitude equals separateness-amplitude.}} \tag{72}$$

A pure sameness state would not be a duplicated existence, while a pure separateness state would not form a stable closure. The charged leptons sit at the balanced seam.

12 Zeroth-order numerical check

Using

$$\vartheta_K = -\frac{2}{9} \tag{73}$$

and the ordering

$$n = 0 \to \tau, \qquad n = 1 \to \mu, \qquad n = 2 \to e, \tag{74}$$

the mass-amplitude ratios are

$$q_\tau : q_\mu : q_e = 2.379438 : 0.580212 : 0.040350. \tag{75}$$

The corresponding mass ratios are

$$\frac{m_\mu}{m_e} \simeq 206.770316, \tag{76}$$

$$\frac{m_\tau}{m_e} \simeq 3477.472837, \tag{77}$$

$$\frac{m_\tau}{m_\mu} \simeq 16.818047. \tag{78}$$

For comparison, the CODATA/PDG charged-lepton reference values are approximately $m_e c^2 = 0.51099895069$ MeV, $m_\mu c^2 = 105.6583755$ MeV, and $m_\tau c^2 \simeq 1776.93$ MeV [7, 8, 9]. The zeroth-order seam value is therefore extremely close at the level of charged-lepton ratios, but not exact at metrological precision.

This mismatch is not treated as an arbitrary defect to be fitted away. In the present reading, the exact Koide form is the topological C_3 balance before the loop is fully embedded in dimensional interaction geometry. Once the closure interacts through an operational metric chart, the primitive topological loop relation does not remain at the pure ratio 1. The metric circumference-diameter relation opens toward

$$1 \longrightarrow \pi. \tag{79}$$

The observed small departure from the zeroth-order Koide ratios is therefore expected to be a finite-density, seam, and occupancy correction associated with this opening from comparator topology into dimensional interaction.

A compact way to write this is

$$\vartheta_{\text{eff}} = -\frac{2}{9} + \delta\vartheta_{\text{dim}}, \tag{80}$$

where $\delta\vartheta_{\text{dim}}$ is not a free numerical decoration, but the first correction caused by the transition from nonmetric closure to metric interaction. The detailed form of $\delta\vartheta_{\text{dim}}$ must come from E_{seam}, E_{curv}, and E_{occ} in the mass functional.

13 From leptonic interiors toward baryogenesis

The lepton construction gives the simplest closed particle interiors. A charged lepton is a complete P_+^H-visible spinorial closure. It can exist as an asymptotic particle because its internal phase-lock is self-closing.

Quark states are expected to differ in one essential respect. They need not be complete one-particle P_+^H closures. They can be partial Z_3-bounded phase classes whose physical visibility requires a threefold comparator. In this reading a baryon is not merely three pre-existing little particles glued together. It is a joint closure of three incomplete internal phase classes:

$$\Gamma_B \sim \Gamma_{q_1} \oplus \Gamma_{q_2} \oplus \Gamma_{q_3}, \qquad \Gamma_{q_i} \text{ not independently complete in } P_+^H. \tag{81}$$

This is where the Koide deviation becomes informative. Leptons already reveal the first correction from pure topological closure to metric interaction through the movement

$$1 \to \pi. \tag{82}$$

Baryons require this correction more deeply, because their closure is not one loop but a coupled Z_3 interaction structure. Fractional charge, color-like confinement, and baryon asymmetry should therefore arise from the same dimensionalization that slightly shifts the charged-lepton Koide balance.

The first Part III result is thus not yet a baryon spectrum. It is the emergence of a controlled bridge:

$$\boxed{\text{alpha-vacuum} \longrightarrow \text{leptonic } 3R/K^2 \text{ closures} \longrightarrow Z_3 \text{ quark closures} \longrightarrow \text{baryonic interiors.}}$$

Leptons establish the phase-lock and mass-amplitude mechanism. Quarks will test whether the same mechanism can be made incomplete, triadic, and color-confined without adding a separate particle ontology.

14 Leptonic chain and baryonic threshold

The alpha-vacuum chain is compressed into the following relations.

$$\alpha_\Phi = \text{minimal neighborhood permeability of vacuum identity}, \tag{83}$$

$$\varepsilon_\Phi : 137.036 \to 125 = \text{retention-to-energy compliance window}, \tag{84}$$

$$\text{Pauli} = \text{separative existence rule}, \tag{85}$$

$$\ell^\pm = \text{closed antipodal spinorial phase-lock}, \tag{86}$$

$$m_\ell c^2 = \text{minimum cost of maintaining closed phase separation}, \tag{87}$$

$$\tau, \mu, e = 1R, 2R, 3R \text{ compliance classes}, \tag{88}$$

$$\sqrt{m_\ell} = C_3 \text{ mass-amplitude of the } 3R/K^2 \text{ seam}. \tag{89}$$

The empirical Koide structure is then the signature of a balanced C_3 seam in mass-amplitude space. The primitive seam generator $-2/9$ is the $1D \to 2D$ interaction factor that preserves the 2^1 antipodal phase when it is carried by the 3^2 phase surface. Its small observed deviation marks the first movement from primitive comparator closure into metric dimensional interaction, where the effective circumference-diameter relation evolves from 1 toward π. The same dimensionalization supplies the natural entrance to partial Z_3 quark closures, fractional charge, confinement-like completion, and ultimately baryogenesis.

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