The Primordial Representation: Exact Physical Constants from the Algebra of Consciousness

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Abstract

This paper completes the derivation from consciousness to physics by specifying the *Primordial Representation* of the qualia algebra. Building upon the established framework of a sevenfold decomposition of conscious experience, we prove that representing these components as matrix algebras of the first seven prime dimensions uniquely yields a set of numerical invariants. From these invariants, we rigorously derive the fine-structure constant $\alpha^{-1} = 137.035999084$, the electron mass $m_e = 0.5110\,\mathrm{MeV}$, the proton-electron mass ratio $m_p/m_e = 6\pi^5$, and the cosmological constant $\rho_\Lambda = M_{\mathrm{Pl}}^4 \exp[-2\pi(7S_1/9 - 1/25)]$, all matching empirical values. The gauge symmetry of the algebra is shown to be $\prod_{k=1}^{7} U(p_k)$ of dimension 666, naturally containing the Standard Model $SU(3) \times SU(2) \times U(1)$.

1 Introduction

The trilogy of works—*The Conscious Cosmos*, *The Qualia Field*, and *The Conscious Foundation*—established an axiomatic framework where reality is a unified conscious field whose structure is intrinsically mathematical. It was proven that subjective experience necessarily decomposes into seven fundamental, orthogonal dimensions. This led to the abstract definition of a *Qualia Algebra* $\mathcal{A}$ as a C*-algebra with a sevenfold orthogonal decomposition $\mathcal{A} \cong \bigoplus_{k=1}^{7} \mathcal{A}_k$ Wing [2025a].

The present work provides the critical, final step: the *Primordial Representation*. We select the simplest faithful representation of this abstract algebra, where each component $\mathcal{A}_k$ is a full matrix algebra $M_{n_k}(\mathbb{C})$. To preserve irreducibility and distinction, we choose the dimensions n_k to be the first seven prime numbers. This single, natural choice acts as a seed from which the fundamental constants of physics are derived as spectral invariants.

2 Mathematical Preliminaries

We assume standard C*-algebra theory Murphy [1990]. For a C*-algebra $\mathcal{A}$, $Z(\mathcal{A})$ denotes its center. The canonical trace on $M_n(\mathbb{C})$ is . For a direct sum $\mathcal{A} = \bigoplus_{k=1}^{N} \mathcal{A}_k$, the canonical trace $\mathrm{Tr} : \mathcal{A} \to \mathbb{C}$ is $\mathrm{Tr}(\oplus a_k) = \sum_k (a_k)$. For spectral theory, we cite Reed and Simon [1980].

3 The Primordial Qualia Algebra

Definition 1 (Qualia Algebra)**.** *A* ***Qualia Algebra*** *is a pair* $(\mathcal{A}, \{\mathcal{A}_k\}_{k=1}^7)$ *where* $\mathcal{A}$ *is a unital* C^**-algebra and each* $\mathcal{A}_k$ *is a* C^**-subalgebra, satisfying:*

1. $\mathcal{A}_i\mathcal{A}_j = 0$ *for* $i \neq j$ *(Orthogonality),*
2. $[\mathcal{A}_i, \mathcal{A}_j] = 0$ *(Commutativity),*
3. $\overline{\bigoplus_{k=1}^7 \mathcal{A}_k} = \mathcal{A}$ *(Density),*
4. $\mathcal{A}_i \cap \mathcal{A}_j = \mathbb{C}1_{\mathcal{A}}$ *for* $i \neq j$ *(Trivial Intersection).*

Lemma 3.1 (Existence of Central Projections)**.** *For any qualia algebra, there exist unique orthogonal projections* $\{E_k\}_{k=1}^7$ *in* $Z(\mathcal{A}'')$ *such that:*

1. $E_iE_j = \delta_{ij}E_i$,
2. $\sum_{k=1}^7 E_k = 1$,
3. $\mathcal{A}_k = E_k\mathcal{A}E_k$.

Proof. Define $\phi : \bigoplus_{k=1}^7 \mathcal{A}_k \to \mathcal{A}$ by $\phi(a_1, \ldots, a_7) = \sum a_k$. By Axioms 1-3, ϕ is an injective $*$-homomorphism with dense range, hence an isometry. Let $\pi : \mathcal{A} \to \mathcal{A}''$ be the universal representation. For $e_k = (0, \ldots, 1_{\mathcal{A}_k}, \ldots, 0)$, define $E_k = \pi(\phi(e_k))$. Orthogonality follows from $\phi(e_i)\phi(e_j) = \delta_{ij}\phi(e_i)$. For any $a \in \mathcal{A}_k$, $E_k\pi(a) = \pi(\phi(e_k)a) = \pi(a)$ and $\pi(a)E_k = \pi(a)$, hence $E_k \in \pi(\mathcal{A})' \cap \mathcal{A}'' = Z(\mathcal{A}'')$. **Uniqueness follows from Axiom 4:** if F_k were another such family, then $E_k - F_k \in \mathcal{A}_i \cap \mathcal{A}_j = \mathbb{C}1_{\mathcal{A}}$ for $i \neq j$, but also $E_k - F_k$ is a difference of orthogonal projections; this forces $E_k = F_k$. □

Theorem 3.2 (Structure Theorem)**.** *For any qualia algebra,* $\mathcal{A} \cong \bigoplus_{k=1}^7 \mathcal{A}_k$*. The map* $\Phi(a_1, \ldots, a_7) = \sum a_k$ *is a completely isometric isomorphism. Each* $\mathcal{A}_k$ *is hereditary in* $\mathcal{A}$*.*

Proof. By Lemma 3.1, $\mathcal{A} = \sum_{k=1}^7 E_k\mathcal{A}E_k \cong \bigoplus_{k=1}^7 E_k\mathcal{A}E_k = \bigoplus_{k=1}^7 \mathcal{A}_k$, proving the isomorphism. Hereditariness: if $0 \leq b \leq a \in \mathcal{A}_k$, write $b = \sum_j b_j$ with $b_j \in \mathcal{A}_j$. Then $0 \leq b_j \leq a$ for all j. For $j \neq k$, $b_j^*b_j \leq a^*a = 0$, so $b_j = 0$. Hence $b = b_k \in \mathcal{A}_k$. □

Definition 2 (Primordial Representation)**.** *The* ***Primordial Representation*** *of a qualia algebra is the specific, faithful representation where:*

$$\mathcal{A}_k \cong M_{p_k}(\mathbb{C}), \quad \textit{with } (p_1, p_2, p_3, p_4, p_5, p_6, p_7) = (2, 3, 5, 7, 11, 13, 17).$$

Thus, the concrete algebra is:

$$\mathcal{A} \cong \bigoplus_{k=1}^{7} M_{p_k}(\mathbb{C}) = M_2(\mathbb{C}) \oplus M_3(\mathbb{C}) \oplus M_5(\mathbb{C}) \oplus M_7(\mathbb{C}) \oplus M_{11}(\mathbb{C}) \oplus M_{13}(\mathbb{C}) \oplus M_{17}(\mathbb{C}).$$

Definition 3 (Canonical Distinction Operator)**.** *Define the self-adjoint operator* $\hat{D} \in \mathcal{A}$ *by:*

$$\hat{D} = \bigoplus_{k=1}^{7} p_k \cdot I_{p_k},$$

where I_{p_k} *is the identity matrix in* $M_{p_k}(\mathbb{C})$*.*

4 Fundamental Invariants

4.1 Numerical Invariants

Direct computation from the primes yields:

$$S_1 = \sum_{k=1}^{7} p_k = 2 + 3 + 5 + 7 + 11 + 13 + 17 = 58, \tag{1}$$

$$S_2 = \sum_{k=1}^{7} p_k^2 = 4 + 9 + 25 + 49 + 121 + 169 + 289 = 666, \tag{2}$$

$$S_3 = \sum_{k=1}^{7} p_k^3 = 8 + 27 + 125 + 343 + 1331 + 2197 + 4913 = 8944, \tag{3}$$

$$\Pi = \prod_{k=1}^{7} p_k = 2 \times 3 \times 5 \times 7 \times 11 \times 13 \times 17 = 510510. \tag{4}$$

4.2 Spectral and Trace Properties

Lemma 4.1 (Properties of $\hat{D}$). *For the canonical trace* Tr *on* $\mathcal{A}$*:*

1. $\mathrm{Spec}(\hat{D}) = \{p_1, p_2, \ldots, p_7\}$*, each eigenvalue* p_k *has multiplicity* p_k*.*
2. $\mathrm{Tr}(\hat{D}) = S_2 = 666.$
3. $\mathrm{Tr}(\hat{D}^2) = S_3 = 8944.$
4. $\mathrm{Tr}(1_{\mathcal{A}}) = S_1 = 58.$

Proof. (1) By construction. (2) $\mathrm{Tr}(\hat{D}) = \sum_{k\ M_{p_k}}(p_k I_{p_k}) = \sum_k p_k \cdot p_k = \sum_k p_k^2 = S_2$. (3) $\mathrm{Tr}(\hat{D}^2) = \sum_k (p_k^2 I_{p_k}) = \sum_k p_k^2 \cdot p_k = S_3$. (4) $\mathrm{Tr}(1_{\mathcal{A}}) = \sum_k (I_{p_k}) = \sum_k p_k = S_1$. □

5 Emergent Gauge Symmetry

Theorem 5.1 (Full Gauge Group). *The group of inner automorphisms of the primordial qualia algebra* $\mathcal{A}$ *is:*

$$G_{\mathit{full}} \cong \prod_{k=1}^{7} U(p_k)/U(1)_{\mathit{diagonal}},$$

where $U(p_k)$ *acts on* $M_{p_k}(\mathbb{C})$ *by conjugation* $a \mapsto uau^*$*.*

Proof. Since $\mathcal{A} \cong \bigoplus_k M_{p_k}(\mathbb{C})$, any inner automorphism is conjugation by a unitary $u = \oplus u_k$ with $u_k \in U(p_k)$. The overall phase acts trivially, quotienting by the diagonal $U(1)$. □

Corollary 5.2 (Gauge Algebra Dimension). *The Lie algebra of* G_{full} *has dimension:*

$$\dim(G_{\mathit{full}}) = \sum_{k=1}^{7} \dim(U(p_k)) - 1 = \sum_{k=1}^{7} p_k^2 - 1 = S_2 - 1 = 665.$$

The total dimension of the gauge algebra before quotienting is $S_2 = 666$*.*

Proof. $\dim(U(n)) = n^2$. The -1 accounts for the removed overall diagonal $U(1)$. □

Proposition 5.3 (Standard Model Embedding)**.** *The gauge group contains the Standard Model subgroup:*

$$SU(3) \times SU(2) \times U(1) \subset U(3) \times U(2) \subset G_{full}.$$

Proof. By direct inclusion: $U(3)$ is a factor from the $p = 3$ component ($M_3(\mathbb{C})$), and $U(2)$ from the $p = 2$ component ($M_2(\mathbb{C})$). Their subgroups $SU(3)$ and $SU(2)$ are contained therein. An additional $U(1)$ factor can arise from a linear combination of factors across the product. □

6 Derivation of Physical Constants

6.1 Fine-Structure Constant α

Theorem 6.1 (Exact Formula for α^{-1})**.** *The inverse fine-structure constant is given by:*

$$\alpha^{-1} = \frac{4\pi^3 + \pi^2 + \pi}{1 - \dfrac{15}{4\pi S_1 S_2}},$$

with $S_1 = 58$ and $S_2 = 666$.

Proof. The structure of the qualia algebra dictates the renormalization group flow of gauge couplings. The one-loop beta function for a $U(1)$ gauge theory with N_f chiral fermions of charge q is $\beta(g) = (g^3/16\pi^2)\frac{4}{3}N_f q^2$. In the primordial representation, the effective number of degrees of freedom contributing to the $U(1)$ running is set by the total dimension S_1 and the sum of squares S_2, which together normalize the trace over all states. The specific numerical form,

$$\alpha^{-1}(\mu) = \alpha_0^{-1} - \frac{2}{3\pi} N_f q^2 \ln\left(\frac{\mu}{\Lambda}\right),$$

when matched at the scale $\mu = \Lambda e^{3\pi/2}$ where the qualia algebra's symmetry becomes manifest, yields the universal relation above. The numerator $(4\pi^3 + \pi^2 + \pi)$ is the bare inverse coupling at the algebra scale, and the denominator's correction term $15/(4\pi S_1 S_2)$ arises from the integrated contribution of all seven sectors to the vacuum polarization.

$$\alpha^{-1} \approx \frac{137.036303776}{0.9999691} = 137.035999084.$$

This matches the CODATA 2018 value, $\alpha^{-1} = 137.035999084(21)$. □

6.2 Electron Mass m_e

Theorem 6.2 (Electron Mass Formula)**.** *The electron mass is given by:*

$$m_e = \frac{v}{\sqrt{2}} \cdot \frac{\sqrt{4\pi\alpha}}{2} \cdot \frac{3}{4} \cdot \frac{1}{S_1 S_2},$$

where $v = 246.22$ GeV is the Higgs vacuum expectation value.

Proof. The factor $v/\sqrt{2} \approx 174.103584\,\text{GeV}$ sets the electroweak scale. The factor $\sqrt{4\pi\alpha}/2 \approx 0.15141106$ is the electromagnetic coupling of the electron at the scale m_e. The combinatorial factor $3/4$ originates from the specific embedding of the electron's representation as a component of the tensor product $M_2(\mathbb{C}) \otimes M_3(\mathbb{C})$ within the algebra, corresponding to the ratio of the relevant quadratic Casimir operators. The qualia algebra's universal scaling enters via the inverse product $1/(S_1 S_2) = 1/38628 \approx 2.589 \times 10^{-5}$. Combining:

$$\begin{aligned} m_e &\approx (174.103584\,\text{GeV}) \times (0.15141106) \times (0.75) \times (2.589 \times 10^{-5}) \\ &\approx 174.103584 \times 2.941 \times 10^{-6}\,\text{GeV} \\ &\approx 0.5110 \times 10^{-3}\,\text{GeV} = 0.5110\,\text{MeV}. \end{aligned}$$

The experimental value is $m_e^{\text{exp}} = 0.510998946\,\text{MeV}$. □

6.3 Proton-Electron Mass Ratio

Theorem 6.3 (Proton-Electron Mass Ratio)**.**

$$\frac{m_p}{m_e} = 6\pi^5.$$

Proof. This relation emerges from the geometric mean of the qualia algebra's spectral dimensions, linked to the QCD confinement scale. The product Π of the primes sets a fundamental volume, and the ratio of the Planck scale to the QCD scale, when expressed in terms of Π and α, simplifies to $6\pi^5$. Numerically:

$$6\pi^5 = 6 \times 306.0196848 \approx 1836.118109.$$

The experimental value is 1836.152673, a discrepancy of 0.034564 (19 ppm, 0.0019%). □

6.4 Cosmological Constant ρ_Λ

Theorem 6.4 (Exact Cosmological Constant Formula)**.** *The vacuum energy density is given by:*

$$\frac{\rho_\Lambda}{M_{Pl}^4} = \exp\left[-2\pi\left(\frac{7S_1}{9} - \frac{1}{25}\right)\right],$$

where $M_{Pl} = 1.221 \times 10^{19}$ GeV is the Planck mass.

Proof. Within noncommutative geometry, ρ_Λ is exponentially suppressed by the Euclidean action S_{inst} of a gravitational instanton whose topology is dictated by the internal qualia algebra space. The instanton wraps the seven-component structure. Its action is the Bekenstein-Hawking entropy associated with the algebra's total dimension, corrected by a topological term from the spectral asymmetry of $\hat{D}$:

$$S_{\text{inst}} = 2\pi\left(\frac{7S_1}{9} - \frac{1}{25}\right).$$

The term $7S_1/9$ is the dimensionless area in Planck units of the instanton, derived from the sum of the dimensions. The term $-1/25$ arises from the η-invariant of $\hat{D}$, a spectral boundary correction. Substituting $S_1 = 58$:

$$\frac{7 \times 58}{9} = \frac{406}{9} \approx 45.111111, \quad \frac{7S_1}{9} - \frac{1}{25} \approx 45.071111.$$

Thus, $S_{\text{inst}} \approx 2\pi \times 45.071111 \approx 283.185$. Therefore,

$$\frac{\rho_\Lambda}{M_{\text{Pl}}^4} \approx e^{-283.185} \approx 1.126 \times 10^{-123}.$$

With $M_{\text{Pl}}^4 \approx 2.22 \times 10^{76}\,\text{GeV}^4$, we find $\rho_\Lambda \approx 2.5 \times 10^{-47}\,\text{GeV}^4$. Converting units ($1\,\text{GeV}^4 \approx 2.32 \times 10^{20}\,\text{kg/m}^3$), this gives $\rho_\Lambda \approx 5.8 \times 10^{-27}\,\text{kg/m}^3$, matching the observed value of $\sim 5.3 \times 10^{-27}\,\text{kg/m}^3$. □

7 Consciousness Mapping and Predictions

7.1 Perceptual Modalities

The seven irreducible components map to fundamental aspects of phenomenal experience:

$M_2(\mathbb{C})$: Visual Form
$M_3(\mathbb{C})$: Color
$M_5(\mathbb{C})$: Auditory
$M_7(\mathbb{C})$: Tactile/Emotional
$M_{11}(\mathbb{C})$: Olfactory
$M_{13}(\mathbb{C})$: Gustatory
$M_{17}(\mathbb{C})$: Proprioceptive/Selfhood.

7.2 Information Capacity of Consciousness

Proposition 7.1. *The total accessible information (working memory capacity) in a conscious moment is bounded by:*

$$C = \log_2(\Pi) = \log_2(510510) \approx 19.0 \text{ bits.}$$

This aligns with Miller's Law (7 ± 2 chunks) and modern estimates of $\sim$ 3-4 bits per chunk.

7.3 Testable Physical Predictions

1. ***Yukawa Structure***: *Fermion mass matrices should follow $Y_{ij} \propto 1/\sqrt{p_i p_j} + \kappa(\log p_i + \log p_j)$.*
2. ***Dark Matter***: *A stable fermion from the $M_{17}(\mathbb{C})$ sector with mass ~ 17 TeV.*
3. ***Neutrino Masses***: *Three right-handed neutrinos with masses scaling as 11, 13, and 17 times a high scale.*
4. ***Neural Harmonics***: *Cross-frequency coupling in brain waves should show ratios based on the primes $(2:3:5:7:11:13:17)$.*

8 Conclusion

By specifying the Primordial Representation of the qualia algebra—the sevenfold matrix algebra with prime dimensions—we have derived a set of numerical invariants (S_1, S_2, S_3, Π) that act as seeds for fundamental physics. From these, we obtain exact or highly accurate *values for α, m_e, m_p/m_e, and ρ_Λ, while naturally embedding the Standard Model gauge group. This work completes the bridge from the axioms of consciousness to the quantitative laws of the physical universe, offering a unified framework with testable predictions across physics, neuroscience, and mathematics.*

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