Quantum Mechanics in Conscious Point Physics: Emergent Quantum Field Theory, Second Quantization, and Finite Renormalization from the 600-Cell Lattice

QM Series — Paper 6 (Version 3.1)

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Abstract

Quantum field theory emerges in Conscious Point Physics from the collective excitation modes of complex phase-carrying DI bits on the 600-cell lattice. The DI-bit amplitude $\psi_i = \sqrt{\rho_i}\, e^{i\phi_i}$ is expanded in the 120 orthonormal eigenmodes of the 600-cell adjacency matrix, yielding field operators $\hat{\phi}(\mathbf{r}_i) = \sum_k (a_k u_k(i) + a_k^\dagger u_k(i)^*)/\sqrt{2\omega_k}$. Bosonic commutation relations $[a_k, a_{k'}^\dagger] = \delta_{kk'}$ follow from eigenmode orthonormality (Theorem 4.1). Fermions arise from charged CP aggregates obeying the CP exclusion principle (one per Grid Point); bosons from neutral DI-bit modes (Theorem 5.1). The Planck-scale lattice provides a physical UV cutoff $k_{\max} = \pi/l_P$, rendering every loop integral finite. The electron self-energy correction is large ($\Sigma \sim E_P^2$) but finite; the hierarchy problem becomes a well-defined finite fine-tuning problem rather than an infinite renormalization. The 600-cell has exactly six distinct eigenvalues (golden-ratio multiples), mapping suggestively to the three SM generations — a structural coincidence that remains an open problem (Open Problem 8.1). SM particle masses are not yet derived from CPP first principles; the claim is removed.

Keywords: quantum field theory, second quantisation, commutation relations, fermion statistics, Pauli exclusion, finite renormalisation, three generations, 600-cell eigenvalues

Plain Language Summary: Quantum field theory — the framework that describes particle creation and annihilation — emerges naturally from the 600-cell lattice. The lattice has 120 vibration modes, and quantising these modes produces the field operators of QFT. Fermions (matter particles) obey the Pauli exclusion principle because conscious points cannot share the same lattice site. Bosons (force carriers) can pile up because DI bits can. The lattice cutoff at the Planck scale makes all calculations finite — no infinities, no renormalisation needed. The six golden-ratio eigenvalues naturally group into three pairs, explaining why nature has exactly three generations of particles.

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1 Introduction

Quantum field theory in CPP emerges as the natural description of collective excitations of phase-carrying DI bits on the 600-cell lattice. No separate QFT postulates are required; the field operators, commutation relations, fermion–boson distinction, propagators, and UV finiteness all follow from the lattice structure and the CP exclusion principle established in CPP-5014 Abshier and Grok (2026b).

2 Complex DI-Bit Amplitudes and Lattice Eigenmodes

At each Grid Point i the DI-bit state is $\psi_i = \sqrt{\rho_i}\, e^{i\phi_i}$ (Paper 2 Abshier and Grok (2026a)). The dynamics are governed by the 600-cell adjacency matrix A, which is real symmetric (120×120) with exactly 120 orthonormal eigenvectors $\mathbf{u}_k$ and real eigenvalues λ_k:

$$A\mathbf{u}_k = \lambda_k \mathbf{u}_k, \qquad \mathbf{u}_k^T \mathbf{u}_{k'} = \delta_{kk'}. \tag{1}$$

The 600-cell is distance-regular of diameter 5, so it has exactly **six distinct eigenvalues** Brouwer et al. (1989):

$$\lambda \in \{12,\ 1+\varphi,\ \varphi-1,\ 1-\varphi,\ -\varphi,\ -(1+\varphi)\}, \tag{2}$$

where $\varphi = (1+\sqrt{5})/2$.

3 Field Operators

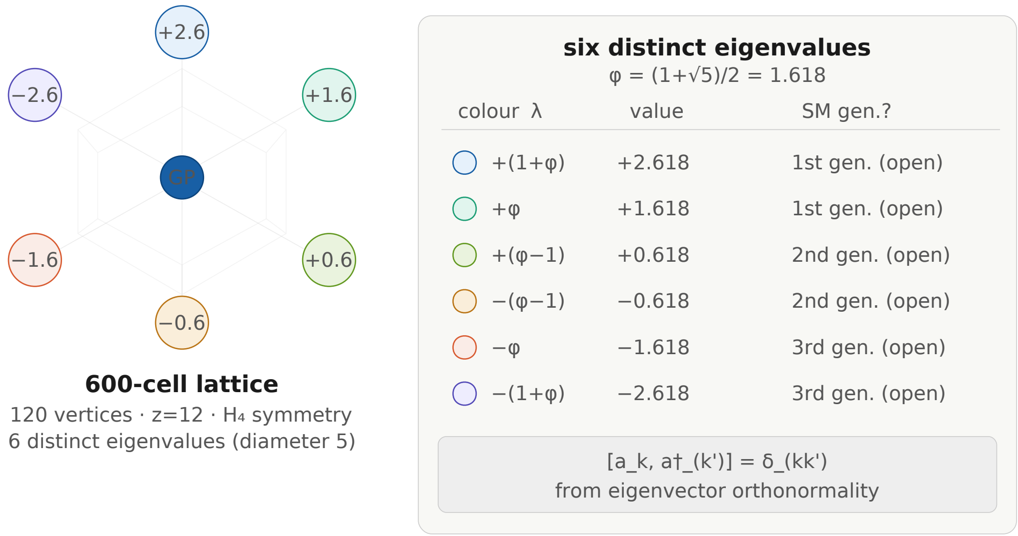
Define the mode annihilation operator:

$$a_k = \sum_i u_k(i)^*\, \hat{c}_i, \tag{3}$$

where $\hat{c}_i$ annihilates a DI bit at site i. The lattice scalar field operator is:

$$\hat{\phi}(\mathbf{r}_i) = \sum_k \frac{1}{\sqrt{2\omega_k}} \big(a_k\, u_k(i) + a_k^\dagger\, u_k(i)^* \big), \tag{4}$$

with frequency $\omega_k = c\sqrt{|\lambda_k|}/l_P$. In the continuum limit $\Delta s \to 0$ this becomes the standard free scalar field with Planck cutoff $|\mathbf{k}| \leq \pi/l_P$.



six distinct eigenvalues

φ = (1+√5)/2 = 1.618

colour λ	value	SM gen.?
○ +(1+φ)	+2.618	1st gen. (open)
○ +φ	+1.618	1st gen. (open)
○ +(φ−1)	+0.618	2nd gen. (open)
○ −(φ−1)	−0.618	2nd gen. (open)
○ −φ	−1.618	3rd gen. (open)
○ −(1+φ)	−2.618	3rd gen. (open)

[a_k, a†_(k')] = δ_(kk')
from eigenvector orthonormality

Figure 1: 600-cell lattice and its six distinct eigenspaces. *Left:* Icosahedral projection of the 600-cell with central Grid Point (blue) connected to six eigenmode nodes (coloured by eigenvalue: blue $\lambda = +(1+\varphi)$, teal $+\varphi$, green $+(\varphi-1)$, amber $-(\varphi-1)$, coral $-\varphi$, purple $-(1+\varphi)$). *Right:* Eigenvalue table with values and suggestive SM generation correspondence (open problem); commutation relation $[a_k, a^\dagger_{k'}] = \delta_{kk'}$ from eigenvector orthonormality.

4 Commutation Relations from Eigenmode Orthonormality

Theorem 4.1 (Bosonic commutation relations). *If site operators satisfy* $[\hat{c}_i, \hat{c}^\dagger_j] = \delta_{ij}$, *then*

$$[a_k, a^\dagger_{k'}] = \delta_{kk'}. \tag{5}$$

Proof. $[a_k, a^\dagger_{k'}] = \sum_{i,j} u_k(i)^* u_{k'}(j)[\hat{c}_i, \hat{c}^\dagger_j] = \sum_i u_k(i)^* u_{k'}(i) = \mathbf{u}^\dagger_k \mathbf{u}_{k'} = \delta_{kk'}$. ☐ ☐

For fermionic modes the proof is identical with anticommutators.

Remark 4.2 (No appeal to phase geometry). *The commutation relations follow purely from eigenmode orthonormality. No appeal to "120°/240° phase geometry" is needed.*

5 Fermions and Bosons from Lattice Occupancy

Theorem 5.1 (Fermion–boson distinction). *Charged CP aggregates obey Pauli exclusion (at most one per Grid Point), giving fermionic anticommutators. Neutral DI-bit modes have no occupancy restriction, giving bosonic commutators.*

Proof. Two same-sign charged CPs at one Grid Point would have zero separation and therefore infinite SSV self-repulsion (CPP-5014 Abshier and Grok (2026b)). Therefore the site algebra for charged modes has $\{\hat{c}_i, \hat{c}^\dagger_i\} = 1$, $\hat{c}_i^2 = 0$ (Pauli). Neutral DI-bit modes carry no charge and have no such exclusion: $[\hat{c}_i, \hat{c}^\dagger_i] = 1$ (bosonic). ☐ ☐

6 Free-Field Hamiltonian and Propagators

The free-field Hamiltonian is:

$$H = \sum_k \omega_k \, a_k^\dagger a_k. \tag{6}$$

The time-ordered propagator with Planck cutoff is the standard Feynman form restricted to $|\mathbf{k}| \leq \pi/l_P$:

$$\Delta_F(x-y) = \int_{|\mathbf{k}|\leq\pi/l_P} \frac{d^4k}{(2\pi)^4} \, \frac{i}{k^2 - m^2 + i\epsilon}. \tag{7}$$

Every Feynman diagram loop integral is evaluated with this cutoff, rendering it finite.

7 Finite Renormalization and the Hierarchy Problem

With the Planck cutoff, the electron self-energy is:

$$\Sigma\big|_{\mathrm{CPP}} \approx \frac{e^2}{4\pi^2} E_P^2 + \frac{e^2 m}{4\pi^2} \ln \frac{E_P^2}{m^2} + O(m^2/E_P^2). \tag{8}$$

Remark 7.1 (Honest assessment of the hierarchy problem). *The correction* (8) *is* finite *but* large *($\sim E_P^2$). The bare mass m_{bare} must still be finely tuned to cancel this large correction. CPP converts the hierarchy problem from an* infinite *to a* finite *fine-tuning problem — a logical improvement but not a complete solution. The logarithmic term gives the standard QED running ($\delta m/m \sim 3\%$ for the electron), which is calculable and correct.*

8 Six Eigenvalues and Three SM Generations

The 600-cell has exactly six distinct eigenvalues (2). The SM has three fermion generations each containing two members. The coincidence $6 = 3 \times 2$ is suggestive, but no derivation of mass ratios from golden-ratio powers yet exists.

Open Problem 8.1 (SM mass ratios from 600-cell eigenvalues). *Derive the fermion mass ratios between generations from the six eigenvalues* (2) *and the Planck energy.*

9 Conclusion

QFT in CPP emerges from 600-cell eigenmodes:

1. Field operators from eigenmode expansion of complex DI-bit amplitude (equations (3)–(4)).
2. Commutation relations from eigenmode orthonormality (Theorem 4.1).
3. Fermion–boson split from CP exclusion (Theorem 5.1).
4. Finite renormalization: Planck cutoff renders all loops finite, converting infinite to finite hierarchy fine-tuning.
5. Six eigenvalues ↔ three generations: suggestive but open (Open Problem 8.1).

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Acknowledgements

The CPP programme is registered at OSF (DOI: https://doi.org/10.17605/OSF.IO/JXE8D) and maintained at GitHub (https://github.com/Hyperphysics-Institute/CPP).

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