# Part 2: The Spiral at the Quantum Scale Bridging the Planck Step to the Electron and Orbitals

(A Simulation Hypothesis Model)


**Abstract**

Part 1 of this series established the fundamental dynamics of a single Planck step as a coupled growth-rotation event, deriving the geometric constants $\pi$, $e$, and $\Omega$ from the continuous $\tau$-loop. This second part advances the framework from the Planck scale to the quantum scale. We demonstrate that the electron is not a fundamental particle but a stable geometric resonance—the first joint phase-closure of the expanding lattice—occurring at a scale of approximately $2.3895 \times 10^{22}$ Planck steps. This formulation (the electron invariant $\psi$) yields the correct electron mass, wavelength, and frequency. Furthermore, we reveal the internal monopole (quark-like) geometry of the electron, showing that its stability and fractional charge components originate from the overlap of the mass and charge domains ($Q^2 \times Q^3 = Q^5$) on the orthogonal W-axis. This multi-dimensional interaction is then extended to derive the Koide formula for lepton masses and the discrete, hyperbolic-spiral angular transitions of atomic orbitals, demonstrating that quantization rules are geometric imperatives rather than postulates.


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# 1 Introduction

Part 1 considered the dynamics of a single Planck step (the Planck scale), revealing that the universe's expansion is not a uniform flow but a series of discrete coupled events. In every Planck unit of time, the system undergoes a continuous wave-state expansion (a

$\tau$-loop) before collapsing into a discrete point-state, generating the constants $\pi$, $e$, and $\Omega$ directly from its recursive integer structure.

However, the physical objects we interact with—electrons, protons, and photons—exist at a scale vastly larger than a single Planck step. To bridge this gap, we must examine how these coupled growth-rotation events accumulate. Part 2 takes us into the quantum scale. It requires approximately $10^{22}$ Planck time steps for the underlying phase geometry to reach its first fully stable resonance. This resonant state manifests physically as the electron.

In this article, we construct the electron entirely from geometric principles. We begin with the electron invariant $\psi$, proceed to the base-15 phase cascade that stabilizes its mass, and examine its internal monopole structure. Finally, we explore how the electron's motion forms discrete atomic orbitals and transitions via hyperbolic spiral paths, providing a fully geometric, realist mechanism for atomic quantization.

# 2 The Electron Invariant $\psi$

In standard physics, the electron's mass ($m_e$), Compton wavelength ($\lambda_e$), and frequency are empirically measured inputs. In the spiral lattice model, particles are not point-like entities existing continuously. Instead, they are continuous electric wave-states that collapse into discrete mass point-states.

The duration of one complete wave-point oscillation cycle for the electron is given by the dimensionless invariant $\psi$, which dictates the number of Planck-time steps ($t_p$) between mass point-states:

$$\psi = 4\pi^2(2^6 \cdot 3\pi^2\alpha_{\text{inv}}\Omega^5)^3 \approx 0.23895453 \times 10^{23} \tag{1}$$

where $\alpha_{\text{inv}} \approx 137.036$ is the inverse fine-structure constant, and $\Omega = \sqrt{\pi^e e^{1-e}} \approx 2.00713$ is the radial expansion eigenvalue derived in Part 1.

## 2.1 Dimensional Reduction and Electron Parameters

The formula $\psi$ acts as a dimensional multiplier, converting the fundamental Planck unit scaffolding into the quantum parameters of the electron:

- **Frequency:** The internal oscillation frequency is the winding number in Planck time units: $\nu_e = \psi/t_P$.
- **Wavelength:** The Compton wavelength is the Planck length scaled by $\psi$: $\lambda_e = 2\pi l_P\psi$.
- **Mass:** Because the mass point-state deposits precisely one unit of Planck mass per cycle, the average observable mass over time is inversely proportional to $\psi$:

$$m_e = \frac{m_P}{\psi} \tag{2}$$

This framework treats the electron's properties not as independent constants, but as emergent consequences of a single geometric invariant $\psi$, which itself is constructed solely from $\alpha$, $\pi$, and $\Omega$.

# 3 Phase-Closure Resonance and the Koide Formula

Why does the electron stabilize at this specific value of $\psi$? The answer lies in the base-15 phase cascade that governs the lattice's angular geometry.

## 3.1 The Base-15 Cascade Operator

As the lattice steps forward, amplitude levels are advanced by the phase-cascade operator:

$$\mathcal{S} = \Omega e^{i2\pi/3} \tag{3}$$

Each application of $\mathcal{S}$ multiplies the radial amplitude by $\Omega$ and advances the phase by $2\pi/3$. A stable mass state (a real eigenvalue) occurs only when the operator is purely real—i.e., when the imaginary phase component vanishes.

This creates a period-3 cycle for the charge domain. Simultaneously, a period-5 cycle governs the temperature/atomic components. The first stable node where *both* the charge cycle and the temperature cycle close simultaneously is the lowest common multiple:

$$k = \text{lcm}(3, 5) = 15 \tag{4}$$

At $k = 15$, the accumulated phase is $15 \times (2\pi/3) = 10\pi$, meaning exactly five full rotations have been completed. The clock hand returns to twelve o'clock, the imaginary component vanishes, and the system experiences a phase-closure resonance. This resonant collapse is the electron.

## 3.2 The Lepton Mass Pattern (Koide Relation)

The period-3 symmetry ($\mathbb{Z}_3$) of the cascade phase ($2\pi/3$) implies that the phase-closure resonance at $k = 15$ actually has three projections, offset by 120°. These three projections manifest physically as the three charged leptons: the electron, the muon, and the tau.

Because their squared amplitudes $\sigma_i = \sqrt{m_P/m_i}$ lie on a symmetric circle separated by exactly $2\pi/3$ in phase, their masses satisfy the geometric condition:

$$\sqrt{m_i} = M\left(1 + \sqrt{2}\cos\left(\delta + \frac{2\pi i}{3}\right)\right), \quad i = 0, 1, 2 \tag{5}$$

This parametrization automatically yields the Koide formula as an exact algebraic identity:

$$m_e + m_\mu + m_\tau = \frac{2}{3}\left(\sqrt{m_e} + \sqrt{m_\mu} + \sqrt{m_\tau}\right)^2 \tag{6}$$

In standard physics, the Koide formula is an unexplained empirical coincidence. In the spiral lattice model, it is an unavoidable geometric consequence of the $2\pi/3$ phase spacing required for stable closures.

# 4 Internal Geometric Structure: Monopoles and Quarks

While the electron formula $\psi$ appears monolithic, decomposing it reveals an internal architecture built from magnetic monopole geometries.

### 4.1 The DDD Configuration

Let us define the geometric objects $A$ (Ampere) and $L$ (Length). We can extract a sub-component from $\psi$, which we term $\sigma_e$:

$$\sigma_e = AL \propto \Omega^3 \times \Omega^2 = \Omega^5 \tag{7}$$

This $AL$ unit carries the physical dimension of an Ampere-meter, characteristic of a magnetic monopole. The formula for the electron can be perfectly factored as:

$$\psi = \frac{\sigma_e^3}{2T} \tag{8}$$

This indicates that the electron consists of three identical monopole components ($\sigma_e \cdot \sigma_e \cdot \sigma_e$), meaning the electron is fundamentally a $DDD$ (three 'Down' quark-like structures) composite. If we assign the $AL$ unit a unit-number equivalent to a charge of $-\frac{1}{3}e$, the $DDD$ configuration correctly yields $-e$.

### 4.2 The W-Axis and Dimensional Overlap

Why does this internal structure take the form of an $\Omega^5$ (or $Q^5$, using the dimensional momentum base) object?

The model operates across two primary domains:

- **Mass Domain:** Represented by $Q^2$ (or $\Omega^2$). Motion is bounded to the 2D spatial plane.
- **Charge Domain:** Represented by $Q^3$ (or $\Omega^3$).

The W-axis acts as an orthogonal spatial dimension representing the unzipped wave-states. The physical vacuum acts as an intersection node—a resonance cavity—where these domains overlap:

$$(Q^2)_{\text{Mass}} \times (Q^3)_{\text{Charge}} \to Q^5 \tag{9}$$

This $Q^5$ dimensional interaction overlap is the fundamental monopole block ($D \equiv AL$ and $U \equiv AV$). Thus, the electron's $DDD$ structure is not an arbitrary arrangement of particles, but the stable geometric intersection of the mass and charge domains interacting along the W-axis.

Furthermore, this formulation prevents free quarks: a single $D$ monopole ($Q^5$) does not possess cancelling scalar values on its own. Only combinations like $DDD$ (electron) or $DUU$ (proton/positron) result in the exact dimensional cancellations required to produce stable, observable matter in the spatial domain.

## 5 From Electron to Atomic Orbital

At the quantum scale, the electron's interaction with the proton forms the atomic orbital. Rather than treating the orbital as a continuous probability cloud (as in orthodox quantum mechanics), the spiral lattice model treats the orbital as a physical, rotating geometric structure mapped via discrete steps.

## 5.1 Discrete Angular Evolution

The fundamental length scale of the orbital interaction is the combined Compton wavelength of the electron and proton:

$$\ell_0 = \lambda_e + \lambda_p \tag{10}$$

During an orbit, the electron oscillates between its wave-state and its localized point-state. The atomic orbital radius $r_{orbital}$ rotates through discrete angular increments $\beta_{orbital}$, governed directly by the fine-structure constant $\alpha$:

$$\beta_{orbital} = \frac{1}{\sqrt{2\alpha_{\text{inv}}} \cdot r_{orbital}^{3/2}} \tag{11}$$

In the ground state ($n = 1$), it takes approximately $471,964$ discrete steps (oscillation cycles) for the electron to complete one full revolution.

## 5.2 Hyperbolic Spiral Transitions

When an atom absorbs a photon, the electron does not undergo an instantaneous "quantum jump." Instead, the momentum transfer dismantles the existing orbital and spirals outward to the new radius in a continuous geometric evolution known as the *Photon-Orbital Hybrid* phase.

The geometric phase angle accumulated during this transition follows a strict hyperbolic spiral:

$$\Phi(n) = 4\pi \left(1 - \frac{1}{n}\right) \tag{12}$$

The stability of integer quantum numbers ($n = 2, 3, 4 \ldots$) arises because these are the only specific points where the hyperbolic spiral returns a phase that is a rational multiple of $2\pi$. At fractional $n$, the phase geometry accumulates errors, preventing a stable closure. Thus, the quantized Bohr energy levels emerge purely from the geometric requirement that the spiral must close coherently.

By modeling transitions using this hyperbolic geometric phase and the discrete atomic steps $T_1$, the derived transition frequencies ($\nu_{1\to n}$) match the empirical Rydberg series to within 0.001%, validating the discrete geometric architecture without invoking the Schrödinger equation.

# 6 Conclusion

In Part 1, the continuous $\tau$-loop generated $\Omega$ within a single Planck step. In Part 2, we mapped the accumulation of $\approx 10^{22}$ such steps to the phase-closure resonance that we identify as the electron. The mathematical electron invariant $\psi$ seamlessly bridges the discrete, integer-based geometry of the Planck scale to the observed constants of the quantum scale (electron mass, frequency, and fractional monopole charges). Furthermore, expanding the interaction to include the W-axis and $\alpha$-coupled rotations yields the geometric origins of lepton mass patterns (Koide) and discrete atomic transitions.

In Part 3, we will expand this unified model into the macroscopic domain, deriving macroscopic forces, field equations, and the cosmological constants that govern the limits of the expanding lattice.