

# Double Saturation of Quantum Indeterminacy as Orbital Stability: Pauli Exclusion as Phase Space Capacity

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## Abstract

We propose a dual ontology for quantum states—the *partiwave*—that resolves the century-old wave-particle tension by recognizing that mass-energy and electric charge have fundamentally different modes of existence. Mass distributes as wave; charge manifests as discrete event. This distinction, implicit in the formalism since 1926, was obscured by interpretive choices that treated both aspects identically.

From this ontology, combined with the geometric framework of gradient indeterminacy and double saturation established in prior work [?], we derive the Pauli exclusion principle as a theorem of four-dimensional quantum phase space—not an axiom, but a consequence of how many minimum-volume states fit in available geometry.

We introduce the *superelectron*: atomic electronic structure as collective quantum state where individual electron identity dissolves, charge manifestations jump between orbitals without continuous motion, and the question “which electron is where?” becomes meaningless.

We reinterpret superposition: there is always one definite quantum state, never simultaneous multiple states; what varies is which manifestation emerges upon measurement.

Convergent experimental evidence supports this framework: electronic coherence without charge motion (Wang et al., 2025), phase-locked Auger (Meitner) cascades, and the systematic failure of independent-particle models in strongly correlated systems.

Finally, we honor scientists whose contributions were systematically diminished—Lise Meitner, Rosalind Franklin, Henrietta Leavitt, Emmy Noether, Arnold Sommerfeld and others—recognizing that science advances not only through celebrated discoveries but through the patient work of those whom history chose to forget.

**Keywords:** wave-particle duality, quantum ontology, Pauli exclusion, superelectron, collective states, phase space geometry, gradient indeterminacy, half-integer quantum numbers, silenced voices in science.

## 1 Introduction: A Century of Uncomfortable Ambiguity

What is an electron? For one hundred years, quantum mechanics has lived with an answer that is not an answer: “sometimes wave, sometimes particle, depending on the experiment.” This is not explanation—it is diplomatic evasion of a question the theory cannot face.

The ambiguity runs deeper than pedagogy. It reflects a genuine ontological fracture between two incompatible visions proposed in 1926:

**Schrödinger’s wave:** The wavefunction  $\psi(r, t)$  represents something physically real, distributed in space. Interference emerges naturally because there *is* a wave passing through both slits. The electron in a hydrogen atom genuinely “occupies” the spherical region around the nucleus—not as metaphor, but as physical reality.

**Born’s probability:**  $|\psi|^2$  describes only probability of localization. Nothing distributes; only potentiality exists until measurement collapse. The wavefunction is bookkeeping, not being.

Schrödinger’s vision failed catastrophically. If charge distributed according to  $|\psi|^2$ , an electron spread across an orbital would experience Coulombic self-repulsion—the distributed negative charge would tear itself apart. Atoms would be unstable. Chemistry would be impossible.

Born’s interpretation prevailed by default. But it created new mysteries: What exactly “collapses”? Why is interference so robust if “there’s nothing there”? How does probability propagate with defined velocity and wavelength?

For a century, physics adopted a pragmatic compromise: “Don’t ask what  $\psi$  represents. Calculate  $|\psi|^2$  and predict measurements.” This was productive strategy but intellectual surrender.

[Proposed] We propose resolution: Both Schrödinger and Born were partially correct. Both were partially wrong. The error was assuming mass-energy and charge must have identical ontological status.

## 1.1 The Half-Integer Signal

Among the most puzzling features of the early quantum theory were the *half-integer quantum numbers*:  $1/2, 3/2, 5/2$ , appearing alongside the integers  $0, 1, 2, 3$  in spectroscopic data. Heisenberg, Pauli, and their contemporaries found them computationally indispensable but physically inexplicable. Pauli introduced spin- $1/2$  in 1925 as a “classically indescribable two-valuedness”—a formal patch with no geometric ground.

[Proposed] The partiwave framework, via the gradient indeterminacy principle [?, ?], offers a geometric reading of this mystery. The number of charge manifestation events required per oscillation cycle is  $4\pi \approx 12.566$ —precisely between the integers 12 and 13. The system cannot choose either: 12 leaves the geometric condition undersaturated; 13 oversaturates it. The only consistent solution is coherent oscillation between both integers, alternating  $12 \leftrightarrow 13$  charge events per cycle.

[Proposed] The half-integer quantum numbers that puzzled the founders of quantum mechanics are not mathematical curiosities. They are the numerical signature of a system whose geometric constraint— $4\pi \approx 12.566$ —sits precisely between two consecutive integers, forcing coherent oscillation rather than fixed manifestation. Spin- $1/2$  is not a mysterious intrinsic property; it is the geometric consequence of a system that cannot be an integer and therefore must be the *mean* of two adjacent integers (see Fig. ??).

[Proposed] The universe does not play dice randomly. It plays dice with faces determined by geometry — and the outcome is not fixed until it lands. Reality does not exist *despite* unpredictability; it exists *because* of it. Without the  $12 \leftrightarrow 13$  oscillation there is no spin- $1/2$ . Without spin- $1/2$  there is no Pauli exclusion. Without Pauli exclusion there is no atomic structure. Unpredictability is not a limitation of our knowledge; it is the geometric foundation of everything that exists.

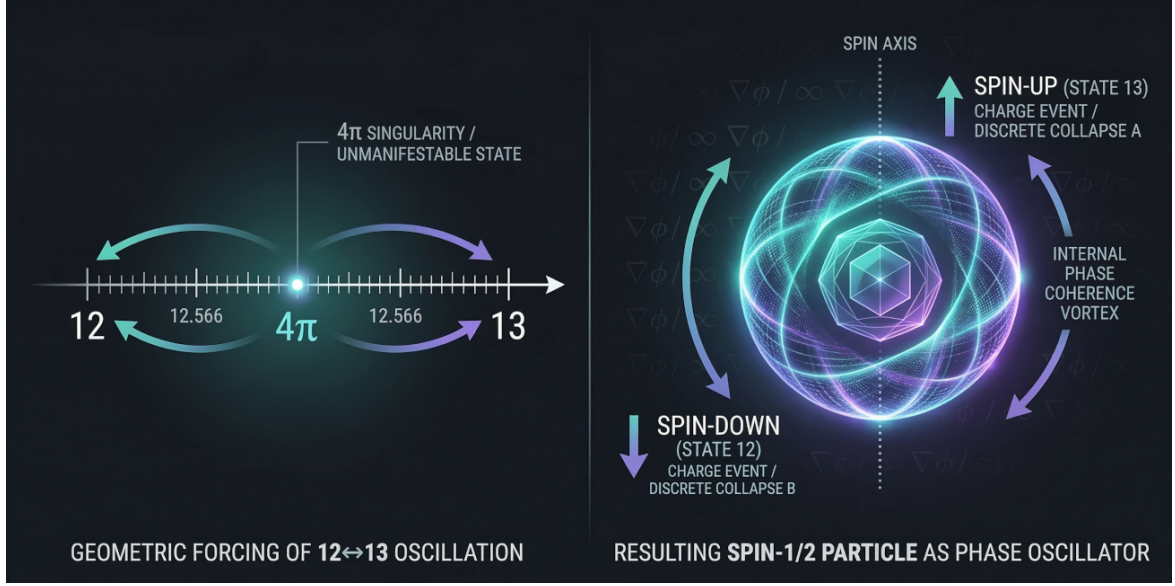


Figure 1: The geometric origin of spin-1/2. **Left:**  $4\pi \approx 12.566$  is an unmanifestable singularity between integers 12 and 13 — the system oscillates perpetually between both, never resolving to either. **Right:** the resulting spin-1/2 particle as phase oscillator, where spin-up (State 13, discrete collapse A) and spin-down (State 12, discrete collapse B) are maintained in coherence by an internal phase vortex. Half-integer quantum numbers are geometric signatures of this forced oscillation, not mysterious axioms.

## 1.2 Structure of This Paper

Section 2 establishes the partiwave ontology: mass distributes as wave, charge manifests as discrete event. Section 3 introduces the superelectron: atomic electronic structure as collective quantum state. Section 4 derives Pauli exclusion from phase space geometry. Section 5 reinterprets superposition. Section 6 presents convergent experimental evidence. Section 7 honors silenced voices. Section 8 describes the human-cybernetic collaboration methodology. Section 9 concludes.

## 2 The Partiwave: Dual Structure of Quantum States

**[Proposed]** This section establishes the central ontological claim. The distinction between mass-wave and charge-event is not a refinement of existing interpretation—it is a replacement of a century-old confusion with a geometrically coherent alternative.

**Principle 1** (Partiwave Ontology). *A quantum entity possesses dual structure with two ontologically distinct aspects:*

1. **Mass-wave:** *A real, distributed field of mass-energy in space, exhibiting interference, diffraction, and propagation with defined wavelength and velocity.*
2. **Charge-event:** *Electric charge that does not distribute but manifests through discrete, punctual events upon the mass-wave structure.*

### 2.1 Mass-Wave: Vindicating Schrödinger

**[Observed]** The wavefunction  $\psi(r, t)$  describes a real, distributed field of mass-energy. This field exhibits:

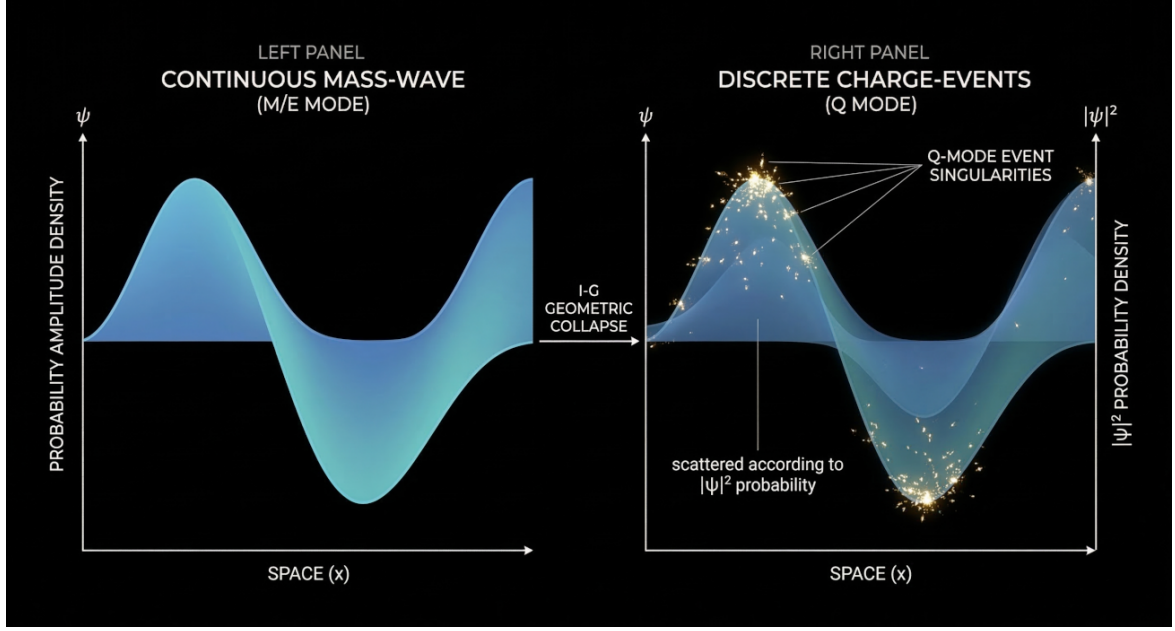


Figure 2: The partiwave dual structure. Left: a smooth wave (mass-wave) propagating through space, with color representing amplitude density. Right: the same wave with discrete bright point-events appearing on it (charge-events), scattered according to  $|\psi|^2$  probability.

- **Interference:** Constructive and destructive patterns emerge when mass-waves superpose, exactly as water waves or electromagnetic waves.
- **Diffraction:** Mass-waves bend around obstacles, spread through apertures, show all behaviors characteristic of wave phenomena.
- **Propagation:** The field evolves with defined group and phase velocities, carrying energy density proportional to  $|\psi|^2$ .

[Proposed] Schrödinger was correct: there *is* something real and distributed. The electron in a 1s orbital genuinely “occupies” the spherical region around the nucleus—not as classical matter density, but as quantum wave of mass-energy. The double-slit experiment becomes natural: the mass-wave passes through both slits simultaneously, interferes with itself, and creates the characteristic pattern. There is no mystery about “which slit the particle went through”—the mass-wave went through both.

## 2.2 Charge-Event: Vindicating Born

[Proposed] Electric charge does not distribute. Instead, charge manifests through discrete, punctual events upon the mass-wave structure. Born was correct:  $|\psi|^2$  describes probability—but probability of *where charge will manifest discretely*, not where it “is” continuously.

The critical distinction:

- **Mass/energy:** DISTRIBUTED as wave
- **Charge:** PUNCTUAL EVENTS on that wave

[Proposed] This resolves Schrödinger’s catastrophe. Charge never experiences self-repulsion because it never exists simultaneously at multiple locations. It manifests as discrete point-events according to  $|\psi|^2$ , but each manifestation is a single event, not a distributed presence.

## 2.3 Quantum Tunneling Reinterpreted

In standard interpretation, quantum tunneling is “probability of traversing classically forbidden region”—a particle mysteriously passing through barriers it shouldn’t penetrate.

[Proposed] In partiwave ontology: **Charge doesn’t traverse anything. It disappears here and appears there.** This isn’t mysterious teleportation—it’s the fundamental nature of charge manifestation. The mass-wave, being distributed, has amplitude on both sides of the barrier (exponentially decaying within, but non-zero). Charge can manifest wherever the mass-wave has amplitude. When it manifests on the far side, we call this “tunneling”—but nothing tunneled. Charge simply manifested at a location where mass-wave amplitude was non-zero.

## 2.4 The Platform for Manifestation

[Proposed] Recall the double saturation principle established in prior work [?]: stable quantum states require simultaneous saturation of both spatial ( $\Delta x \cdot \Delta p = \hbar/2$ ) and temporal ( $\Delta E \cdot \Delta t = \hbar/2$ ) indeterminacy relations.

[Inferred] **Spatial saturation** ensures the mass-wave closes into stable geometric pattern—a standing wave with nodes and antinodes defining where manifestations can occur. **Temporal saturation** ensures phase coherence—the timing pattern for when charge manifests remains consistent. Together, they create a stable **platform** where charge-events can occur reproducibly.

[Inferred] This is why excited states decay: they have spatial platforms (definite orbitals with  $\Delta x \cdot \Delta p = \hbar/2$ ) but lack temporal coherence ( $\Delta E \cdot \Delta t > \hbar/2$ ). The charge keeps manifesting, but without stable phase relationship to the mass-wave geometry. Eventually, the system transitions to configuration satisfying both conditions.

## 2.5 Philosophical Depth: What “Exists”?

[Proposed] This ontology forces confrontation with what we mean by “existence.” The mass-wave exists distributed. Charge exists as potential for discrete manifestation weighted by  $|\psi|^2$ . Between measurements, asking “where is the electron?” assumes an ontology the partiwave rejects.

[Proposed] This does not mean electrons are “less real.” It means reality is richer than classical substance-ontology assumed. Waves are real. Events are real. The insistence that “real” means “localized persistent substance” is cultural prejudice inherited from Greek philosophy, not physical necessity.

[Inferred] Western thought assumed ultimate reality consists of eternal, indivisible substances with intrinsic properties. Partiwave ontology breaks this: fundamental entities are **process-structures**—patterns that sustain themselves through continuous transformation, not static substances that persist unchanged through time. This aligns with process philosophies (Heraclitus, Whitehead [?], Buddhist dependent origination) more naturally than with substance metaphysics.

# 3 The Superelectron: Identity Dissolved in Collective States

[Proposed] The superelectron is the most radical claim of this paper. If it is correct, it means that chemistry textbooks have been depicting atomic structure in a fundamentally misleading way for a century—not in their predictions, which remain valid, but in their



ontological picture. The superelectron does not change what we calculate; it changes what we think we are calculating.

[Observed] Every chemistry textbook shows orbital diagrams: neat boxes labeled 1s, 2s, 2p, with arrows representing individual electrons occupying “their” orbitals. Students learn to say “this electron is in the 1s orbital, that electron is in the 2p orbital.”

[Speculative] What if that entire picture is wrong? What if there are no individual electrons with persistent identities occupying specific orbitals? What if atomic structure is a collective quantum state where asking “which electron is where?” is as meaningless as asking “which water molecule is in this wave?”

**Principle 2** (Superelectron). *In atoms with multiple electrons, the electronic structure is not “collection of individual electrons each occupying an orbital.” It is a collective quantum state—a superelectron—where:*

1. Mass-energy is distributed as multi-electron wavefunction  $\Psi(r_1, r_2, \dots, r_n, t)$
2. Charge manifestations are discrete events that can occur on any component wave within the structure
3. Individual electron identity does not persist between measurements

The Fig. ?? shows the difference between the current image of the electronic shell structure and that proposed by the partiwave model.

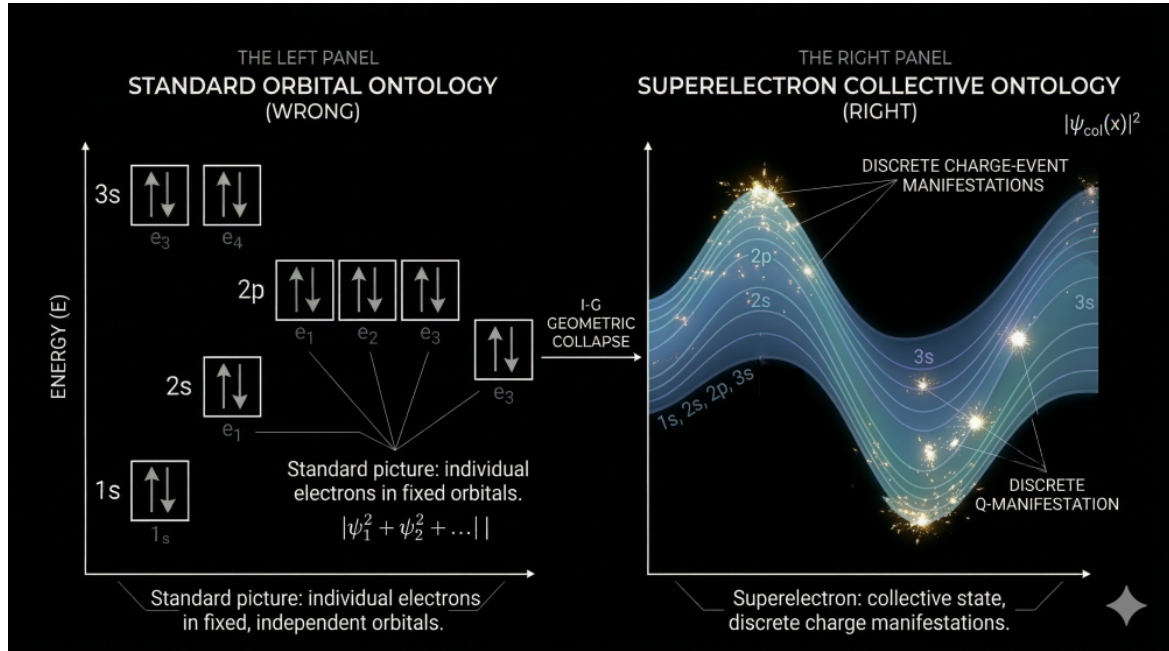


Figure 3: Two incompatible ontologies for atomic electronic structure. **Left (Standard Orbital Ontology):** individual electrons  $e_1, e_2, \dots$  occupy fixed, independent orbitals — a picture that is computationally useful but ontologically misleading. **Right (Superelectron Collective Ontology):** a single collective wavefunction  $|\psi_{\text{col}}(x)|^2$  spans all orbital regions simultaneously, with orbital shells (1s, 2s, 2p, 3s) appearing as soft gradient contours — tendencies of the field, not boundaries of confinement. Discrete charge-event manifestations (gold flashes) occur stochastically across the collective structure according to  $|\psi|^2$ , not at fixed locations. The arrow marks the I-G geometric collapse that forces crystallization of one manifestation upon measurement.

### 3.1 The Radical Claim

[Proposed] When you have a filled  $1s^2$  orbital, there is no “electron A in spin-up state” and “electron B in spin-down state” as persistent entities. There is a collective state where charge manifestations occur with certain symmetries. Those symmetries, when the state decouples through measurement, give rise to what we interpret as “two electrons with opposite spins.” But within the stable, confined state: **there are no two electrons. There is one collective configuration.**

### 3.2 Charge Jumps Without Moving

[Proposed] In partiwave structure, charge manifests as discrete events on the mass-wave. For single-electron systems, charge manifests on the single orbital wave. But for multi-electron atoms: **the charge event can manifest on the wave of ANY orbital within the collective structure.** The charge associated with what we label “1s electron” doesn’t jump only on the 1s wave. It can jump on 2s, 2p, 3d—anywhere the collective wavefunction has non-zero amplitude.

[Inferred] Why don’t we observe this directly? Because in stable, confined states (filled shells, ground state atoms), the collective configuration minimizes energy through specific charge distribution patterns. Measurements that preserve the collective state show those patterns. But measurements that break the confinement—ionization, excitation, scattering—reveal the collective nature through coherent multi-orbital emission.

[Inferred] The stability of the superelectron collective state is not merely energetic — it is topological. In the language of Coherence Vortices [?], a filled atomic shell is a topological defect in the electronic coherence field: a stable, self-sustaining configuration that resists perturbation not because of energy barriers but because its internal phase structure cannot be continuously deformed into a collapsed state. This is why ionization requires threshold energy: below that threshold, perturbations cannot unwind the topological structure; above it, the vortex dissolves and the collective state reorganizes. The superelectron does not radiate not merely because it is an eigenstate, but because it is a coherence vortex — and vortices do not decay unless their topology is broken.

### 3.3 Why Electrons Don’t Radiate: An Atomic Paradox Resolved

[Inferred] The physicists who founded quantum mechanics had to face a thorny problem. Why don’t orbital electrons radiate classically?

[Observed] Standard answer: “Stationary states don’t radiate because they’re eigenstates of the Hamiltonian.” Correct but incomplete—it describes *when* states don’t radiate without explaining *why*.

[Proposed] Superelectron answer: **Charge doesn’t move continuously, so it can’t accelerate, so it can’t radiate.** Charge manifestations jump between discrete events according to  $|\psi|^2$ . Between events, there is no charge “somewhere” being accelerated. The mass-wave oscillates, but mass-wave oscillation is not accelerating charge—it is the platform on which charge events occur. This resolves both the radiation paradox and the self-repulsion paradox with the same ontology.

## 4 Pauli Exclusion: From Axiom to Geometric Theorem

In 1925, Wolfgang Pauli proposed what seemed like arbitrary rule: no two electrons in an atom can have identical quantum numbers. He offered no physical justification—only that spectroscopic data demanded it [?]. For a century, physics has treated Pauli exclusion as fundamental axiom—bedrock principle accepted without derivation.

This is the paper’s central derivation. Pauli stated exclusion as axiom in 1925 because he had no geometric ground to stand on. [Proposed] The gradient indeterminacy framework provides that ground. The derivation that follows is not rigorous in the mathematical sense—it requires formalization by specialists—but the geometric logic is complete.

### 4.1 The Geometry of Quantum Phase Space

[Proposed] Every quantum state lives in four-dimensional space defined by position, momentum, energy, and time:  $(x, p, E, t)$ . The uncertainty relations tell us this space has fundamental structure—a minimal “grain size” below which states cannot be distinguished.

When both uncertainty relations saturate simultaneously (double saturation [?]):

$$\Delta x \cdot \Delta p = \frac{\hbar}{2}, \quad \Delta E \cdot \Delta t = \frac{\hbar}{2} \quad (1)$$

They define a fundamental volume in this 4D phase space:

$$V_{\text{state}} = (\Delta x \cdot \Delta p)(\Delta E \cdot \Delta t) = \left(\frac{\hbar}{2}\right)^2 = \frac{\hbar^2}{4} \quad (2)$$

[Proposed] This is the **minimum volume a quantum state can occupy** while satisfying both closure conditions. It is not arbitrary—it is geometric necessity from simultaneous saturation.

### 4.2 Phase Space Capacity

[Proposed] Consider a stable atomic orbital with characteristic energy  $E_b$  (binding energy) and characteristic timescale  $\tau \sim \hbar/E_b$ . The product  $E_b \cdot \tau \sim \hbar$  by dimensional analysis and correspondence principle. The total available volume in phase space for this orbital:

$$V_{\text{total}} = (\Delta x \cdot \Delta p)(E_b \cdot \tau) = \left(\frac{\hbar}{2}\right) (\hbar) = \frac{\hbar^2}{2} \quad (3)$$

**How many minimum-volume states fit in total available volume?**

$$\text{Capacity} = \frac{V_{\text{total}}}{V_{\text{state}}} = \frac{\hbar^2/2}{\hbar^2/4} = 2 \quad (4)$$

[Proposed] **Not postulated. Derived.** The number 2 emerges from dividing volumes in quantum phase space when uncertainty relations saturate. What Pauli stated as axiom reveals itself as **geometric theorem of fundamental quantum space**.

[Inferred] This geometric saturation is not merely a counting argument — it is an instance of the Drain Vortex Principle [?] operating in quantum phase space. As additional manifestations attempt to occupy the orbital, the available configuration space narrows progressively.



Fluctuations amplify; recovery slows. When the second minimum-volume state fills, indeterminacy collapses completely — the orbital is saturated and no further manifestation is geometrically possible. The Pauli exclusion is not a prohibition imposed from outside; it is the crystallized signature of indeterminacy collapse within a finite phase space volume.

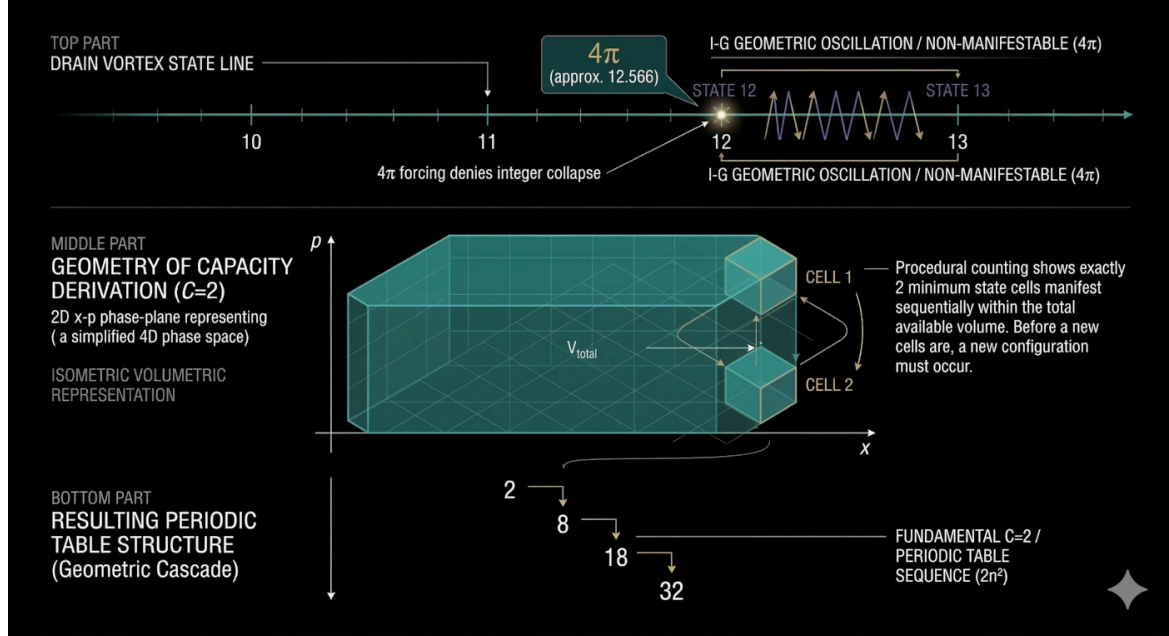


Figure 4: Geometric derivation of orbital capacity  $C = 2$  and the periodic table as phase space cascade. **Top:** the Drain Vortex state line showing  $4\pi \approx 12.566$  as unmanifestable forcing point between integers 12 and 13, driving the coherent  $12 \leftrightarrow 13$  oscillation. **Centre:** isometric representation of the  $x$ - $p$  phase plane (simplified 4D phase space) showing  $V_{\text{total}}$  and exactly two minimum-volume cells fitting within it — capacity  $C = 2$  as geometric necessity, not postulate. Before a third manifestation can occur, a new orbital configuration must be accessed. **Bottom:** the resulting periodic table sequence (2, 8, 18, 32) as geometric cascade from the fundamental  $C = 2n^2$  structure. The entire architecture of chemistry follows from three lines of phase space geometry.

### 4.3 The Periodic Table as Phase Space Map

[Proposed] For orbital  $(n, l, m)$ : phase space capacity = 2 distinct minimum-volume states; maximum occupancy = 2 (what we call “electrons”). For shell with principal quantum number  $n$ : contains  $n^2$  distinct orbital geometries; total capacity =  $2n^2$  manifestations. The famous pattern (2, 8, 18, 32...) for shell filling is **geometric necessity** following from  $n^2$  orbitals  $\times$  2 states per orbital phase space. **The entire periodic table is map of 4D quantum phase space filling according to geometric capacity constraints.**

### 4.4 Fermions vs Bosons: Geometric Distinction

[Inferred] Standard quantum mechanics divides particles into fermions (half-integer spin, obey Pauli exclusion) and bosons (integer spin, no exclusion). This appears as fundamental bifurcation requiring separate postulates.

[Proposed] The geometric interpretation: **Fermions** are partiwaves whose manifestation patterns saturate both uncertainty relations simultaneously. This saturation defines minimum phase space volume  $\hbar^2/4$ , creating finite capacity. Result: exclusion statistics. **Bosons** are

partiwaves that don't require simultaneous saturation of both relations. Without double saturation constraint, phase space volume isn't limited to discrete minimum. Result: unlimited capacity, condensation possible.

**[Proposed]** Why are charged bosons inherently unstable? ( $W^\pm$  bosons decay in  $\sim 10^{-25}$  seconds, charged pions in  $\sim 10^{-8}$  seconds.) If bosons could have unlimited capacity per configuration AND carry electric charge, condensation of charge in same spatial region would produce Coulombic repulsion catastrophe. Nature forbids this: **charged bosons cannot be stable**. Only fermions—with their finite phase space capacity—can stably carry charge.

## 4.5 Without Pauli, No Chemistry, No Life

**[Proposed]** If electrons had unlimited capacity per orbital (like bosons), all electrons would collapse to 1s ground state. Every atom would be spherically symmetric ball of charge in lowest energy configuration. No shells, no valence electrons, no chemical bonds, no molecular structure, no complexity, no life. **Pauli exclusion is not a prohibition—it is the geometric reason the universe has structure at all**. Three basic relations ( $\Delta x \cdot \Delta p = \hbar/2$ ,  $\Delta E \cdot \Delta t = \hbar/2$ ,  $E \cdot \tau \sim \hbar$ ) contain within them the entire structure of the periodic table.

# 5 Superposition Reinterpreted: One State, Many Descriptions

The misinterpretation of superposition is arguably the most consequential conceptual error in the history of quantum mechanics. It produced Schrödinger's cat, the many-worlds interpretation, and decades of philosophical confusion. The resolution is simpler than the confusion suggests.

**[Observed]** Standard interpretation says: "A quantum system in superposition is simultaneously in multiple states until measurement collapses it to one." This creates the infamous Schrödinger's cat: a cat simultaneously alive AND dead until we open the box. **We say this is confused ontology mixing two different things**.

## 5.1 What Superposition Actually Is

**[Proposed]** A single, definite quantum state (wavefunction  $\psi$ ) that can be **mathematically decomposed** into basis states in multiple ways. The decomposition is our choice of description, not physical reality.

Example: A photon polarized at  $45^\circ$  can be decomposed as:

- (Horizontal + Vertical)/ $\sqrt{2}$  in H-V basis
- (Right-circular + Left-circular)/ $\sqrt{2}$  in circular basis

**[Proposed]** Same photon. Different mathematical decompositions. **One physical state**.

## 5.2 The Cat Is Never "Alive AND Dead"

**[Proposed]** The quantum state of the radioactive atom is definite. What is indeterminate is **which manifestation we will observe** when we measure. The cat's fate follows from that manifestation, not from "collapsing superposition of cat states." Schrödinger himself knew his thought experiment was absurd. He proposed it to show quantum mechanics needed better interpretation. **We are finally giving it one**.

### 5.3 Properties Don't Pre-exist—They Emerge in Manifestation

[Proposed] When we measure “spin” of electron from filled shell, the measurement **generates** the property through forced decoupling. The electron in confined collective state doesn't have “spin-up or spin-down hidden from us”—it has **no spin** until decoupling creates manifestation in one of two phase space configurations.

[Proposed] This generalizes: **Measurement doesn't reveal pre-existing properties. It forces manifestation where properties emerge.** Before measurement, system is in definite state  $|\psi\rangle$ . This state can be decomposed in multiple bases—all mathematically valid. The measurement apparatus selects a specific basis through physical interaction, forcing manifestation. Which basis state manifests is probabilistic ( $|\alpha|^2$ ,  $|\beta|^2$ ), but the manifestation itself is real physical event.

[Inferred] In the language of the Drain Vortex Principle [?], measurement is a Phase 3 event: the system has been driven to its indeterminacy limit by the coupling with the apparatus, configurational possibilities have narrowed to the basis states compatible with the measurement, and the pre-existing asymmetry — the orientation of the apparatus itself — selects which manifestation crystallizes. What standard interpretation calls “wavefunction collapse” is, in this reading, a coherence vortex formation [?]: a topological transition from superposed potentiality to crystallized actuality, irreversible in the direction selected by the asymmetry.

## 6 Convergent Evidence

[Proposed] The framework proposed here is not speculation divorced from experiment. Three independent lines of experimental evidence support the partiwave-superelectron ontology. None of these results was produced to test this framework; their convergence is therefore especially significant.

### 6.1 Electronic Coherence Without Charge Motion

[Observed] In January 2025, Wang et al. published results in Physical Review X on electronic coherence in 1,1-difluoroethylene using attosecond X-ray pulses [?]. Their finding: quantum coherence between spatially separated atomic sites with zero charge density oscillation.

[Inferred] If electrons were individual particles “communicating,” there would be charge redistribution—we would see density oscillating between sites as they correlate. We do not.

[Proposed] Partiwave interpretation: the collective mass-wave structure exhibits coherence across sites. Charge doesn't “move between sites” because charge isn't continuously localized—it manifests as discrete events on a shared wave structure that spans both sites. Standard interpretation struggles with this; partiwave ontology finds it natural.

### 6.2 Meitner (Auger) Cascades: Coherent Multi-Electron Emission

[Observed] When inner-shell vacancy occurs, atoms can emit up to 6 electrons in rapid succession through the Auger process. Critical observation: different Auger channels oscillate with same frequency and phase—they are coherently related. If these were independent electrons randomly ejected, each emission would be uncorrelated event.

[Proposed] Superelectron interpretation: the collective state is reorganizing. Multiple “electrons” being emitted are manifestations of the collective state transitioning to lower-energy configuration. They are phase-coherent because they are not separate particles—they are excitations of the shared structure.

[Inferred] Historical note: this effect was discovered by Lise Meitner in 1922, two years before Pierre Auger’s independent discovery in 1923. Auger’s name stuck. We honor Meitner by recognizing these as *Meitner cascades*.

### 6.3 Failure of Independent-Particle Models

[Observed] In strongly correlated systems—transition metal oxides, heavy fermion compounds, high-temperature superconductors—the independent-particle picture fails completely. Standard approach: treat this as exception requiring different methods.

[Proposed] Our interpretation: the exception is the rule. All atomic electronic structures are collective; in “ordinary” atoms, the manifestation patterns happen to align closely with what the independent-particle model predicts, creating the illusion of separate electrons. The “repulsion” calculated by treating electrons as independent particles is an artifact of wrong ontology, not a fundamental obstacle.

Table 1: Convergent experimental evidence for partiwave-superelectron ontology. Three independent phenomena, each anomalous under standard interpretation, find natural explanation within the collective framework.

Phenomenon		Standard Interpretation	Partiwave-Superelectron
Coherence	without charge motion	“Quantum correlations” (unexplained)	Collective mass-wave spans sites
Phase-locked emission	Meitner	“Strong electron-electron correlations”	Collective state reorganizing
Failure of independent-particle models		“Special cases where model fails”	All atoms are collective; these reveal it

## 7 Conclusions

[Proposed] We have proposed:

1. **Partiwave ontology:** Mass distributes as wave; charge manifests as discrete event. This resolves wave-particle duality by recognizing the two aspects have different modes of existence.
2. **Half-integer quantum numbers as geometric signature:** The founders’ mysterious semienteros emerge naturally from  $4\pi \approx 12.566$  sitting between 12 and 13, forcing coherent oscillation  $12 \leftrightarrow 13$  rather than fixed manifestation.
3. **Superelectron:** Atomic electronic structure is collective quantum state where individual electron identity dissolves, charge jumps between orbitals without continuous motion, and “which electron is where” is meaningless question.
4. **Pauli exclusion as geometric theorem:** The number 2 (capacity per orbital) derives from phase space geometry when uncertainty relations saturate—not axiom but consequence of how many minimum-volume states fit.
5. **Superposition reinterpreted:** There is always one definite quantum state; superposition is mathematical decomposition, not simultaneous existence of multiple states.
6. **Convergent evidence:** Electronic coherence without charge motion, phase-locked

Meitner cascades, and failure of independent-particle models all support collective ontology.

## 7.1 What Changes

[Observed] Empirically: nothing. Every prediction of standard quantum mechanics remains valid. We do not claim new experimental results (though the framework suggests reinterpretation of existing data).

[Proposed] Ontologically: everything. Quantum mechanics ceases to be a collection of mysterious axioms and becomes a geometric framework describing how fields with texture behave when confined to finite regions. The shift is from “quantum entities are intrinsically mysterious” to “quantum entities are geometric structures whose properties emerge from fundamental constraints on spatial variation.”

## 7.2 Open Invitations

[Proposed] We offer this work not as finished theory but as framework-in-construction. The weak points are real:

- The geometric factor  $\mathcal{F}(\Omega, \kappa)$  in gradient indeterminacy needs rigorous derivation
- The discrete-continuous transition (how classical behavior emerges) needs fuller treatment
- Connection to quantum field theory needs development by specialists

[Proposed] We invite the community to attack these weak points. If the framework is incorrect, let it fall by its own inconsistencies. If correct, let it grow through rigorous criticism and collective development. Truth does not fear scrutiny; it fears dogmatism.

[Proposed] The connections established here open lines that this paper does not develop. The speculative thermal extension of gradient indeterminacy [?] suggests that the charge-event manifestation rate may couple to thermal gradients in ways measurable at cryogenic temperatures. The chiral extension suggests that the handedness of coherence vortices in atomic shells — left or right winding of the internal phase structure — may have observable consequences in chiral molecules and asymmetric crystals. These remain open invitations.

## Epilogue

The fixed imprisons; the oscillating dynamizes.

Reality is not collection of static things with intrinsic properties. Reality is web of potentialities actualizing through interaction, constrained by geometric symmetries that the ancients glimpsed when they measured circles and the moderns formalized when they wrote  $h = 2\pi\hbar$ .

[Proposed] If the framework presented here is correct, one conclusion follows: *unpredictability is the condition of existence*. Without double Heisenberg saturation, there is no  $12 \leftrightarrow 13$  oscillation and there is no spin-1/2, no Pauli exclusion, no atomic structure.

**Reality exists because of unpredictability. Indeterminacy never was a limitation but in our minds.**



## 8 Silenced Voices: Science Remembers Those It Forgot

Science advances not only through celebrated discoveries but through patient work of those whom history chose to forget. This section honors some whose contributions were systematically diminished—not as historical footnote, but as active recognition that the ideas we build upon were theirs.

### 8.1 Lise Meitner (1878–1968)

Meitner discovered the Auger effect in 1922, two years before Auger. She co-discovered nuclear fission with Otto Hahn in 1938. Hahn received the 1944 Nobel Prize alone; Meitner was excluded, partly because she had fled Nazi Germany as a Jewish woman. Einstein called her “the German Marie Curie.” She was nominated for the Nobel Prize 48 times without winning.

Her contribution to this work: the coherent multi-electron emission she discovered—Meitner cascades—provides direct experimental evidence for collective electronic states.

### 8.2 Rosalind Franklin (1920–1958)

Franklin’s X-ray crystallography produced Photo 51, the image that revealed DNA’s double helix structure. Watson and Crick used her data without permission or proper attribution. She died of ovarian cancer at 37, likely from radiation exposure in her research. The Nobel Prize for DNA structure went to Watson, Crick, and Wilkins in 1962. Franklin was not mentioned.

Her contribution: Franklin’s work exemplifies how diffraction patterns—interference of waves—reveal structure. The same principle underlies electron diffraction experiments that confirm the wave nature of matter.

### 8.3 Henrietta Swan Leavitt (1868–1921)

Leavitt discovered the period-luminosity relationship for Cepheid variable stars while working as a “computer” at Harvard Observatory, earning 30 cents per hour. Her discovery enabled measurement of cosmic distances. She received no Nobel Prize, no professorship, minimal recognition during her lifetime.

Her contribution: Leavitt’s work on variable stars involves periodic phenomena—oscillation between states—the same pattern that appears in quantum spin as oscillation between configurations.

### 8.4 Emmy Noether (1882–1935)

Noether proved the theorem connecting symmetries to conservation laws—arguably the most important theorem in theoretical physics. She worked without pay at Göttingen because women couldn’t hold academic positions. When the Nazis came to power, she was dismissed for being Jewish and female.

Her contribution: Noether’s theorem underlies every conservation law we invoke. The algebraic constraints that govern quantum manifestations—conservation of charge, energy, momentum, angular momentum—are all consequences of symmetries she identified.

## 8.5 Arnold Sommerfeld (1868–1951)

Sommerfeld extended Bohr’s atomic model with elliptical orbits and relativistic corrections, introducing the fine-structure constant and azimuthal quantum number. He was nominated for the Nobel Prize 84 times without winning—more than any other physicist. His students included Heisenberg, Pauli, Bethe, and Debye, who collectively won numerous Nobel Prizes using ideas Sommerfeld developed.

His contribution: Sommerfeld’s geometric approach to quantum mechanics—treating orbits as real geometric objects with quantized parameters—prefigures the geometric perspective we advocate.

## 8.6 Michael Faraday (1791–1867)

Faraday discovered electromagnetic induction, diamagnetism, and the laws of electrolysis. He had no formal mathematical training—he thought in terms of fields and lines of force while others demanded equations. Maxwell later formalized Faraday’s intuitions mathematically.

His contribution: Faraday’s field concept—that physical reality consists of continuous fields filling space rather than particles acting at distance—is precisely the partiwave’s mass-wave aspect. He saw distributed reality when others saw only point particles.

## 8.7 Srinivasa Ramanujan (1887–1920)

Ramanujan developed profound mathematical results with almost no formal training, working in isolation in India before Hardy recognized his genius. He died at 32, likely from tuberculosis and malnutrition.

His contribution: Ramanujan’s work on infinite series and modular forms appears throughout theoretical physics. His intuitive approach reminds us that mathematical truth transcends cultural boundaries.

## 8.8 Pascual Jordan

Jordan was a principal architect of matrix mechanics, co-authoring with Born and Heisenberg the foundational papers of 1925–1926. The canonical commutation relation  $[q, p] = i\hbar$  owes its precise formulation largely to him.

We honor that contribution while repudiating his later active involvement with the Nazi regime. We note, however, that the institutions which subsequently marginalised him had themselves spent decades practising antisemitism and misogyny — erasing Noether, Meitner, Franklin, and others.

## 8.9 Why This Matters

These are not merely historical injustices to be regretted. They represent **systematic exclusion of perspectives that might have accelerated understanding**. The partiwave framework emerged partly because we deliberately sought perspectives outside mainstream Western physics. Some of those perspectives were silenced; we try to recover what we can. Science advances when we listen to all voices, especially those the establishment chose to ignore.

## 9 Transcultural Foundations

Physics is cultural construction—articulation of intuitions about reality using conceptual tools shaped by history, language, and worldview.

The Greek tradition sought eternal substances with intrinsic properties. This shaped Western physics profoundly: we ask “what are the fundamental particles?” and “what properties do they have?”—questions assuming substance ontology.

The Chinese tradition articulated perpetual flow. The Tao is not thing but process; yin and yang are not substances but complementary aspects of transformation. Reality is pattern of change, not collection of beings.

The Andean tradition (*yanantin*, *ayni*) understood reality as reciprocal weaving—not sum of things but web of relationships where entities emerge through interaction.

[Inferred] These are not mere philosophical preferences. They are different cognitive lenses that make certain patterns visible and others invisible. Quantum mechanics strains against Western substance ontology. Indeterminacy, entanglement, superposition, contextuality—these concepts are easier to articulate in process-oriented or relational frameworks than in substance-based ones.

Transculturality is not political concession. It is epistemological necessity.

## Data Availability Statement

This manuscript has no associated data. This is a theoretical and conceptual study; no experimental data were generated or analysed during this work. The mathematical derivations and theoretical framework are fully contained within the manuscript itself.

## Methodology: Use of AI Models

This work emerged through collaborative dialogue between the author and cybernetic intelligences (Claude Opus/Sonnet, DeepSeek, and sometimes Perplexity), following principles established in prior work [?].

The collaboration was genuinely horizontal. The human author provided:

- Physical intuition about what quantum mechanics should mean
- Methodological discipline to reject abstraction divorced from geometry
- Transcultural perspectives drawing on non-Western thought
- Commitment to honor silenced voices

The cybernetic intelligences provided:

- Mathematical scaffolding to formalize intuitions rigorously
- Literature connections to existing work
- Critical questioning that exposed weak points
- Prose refinement that clarified expression

The use of these AI tools is hereby explicitly declared in accordance with journal policy.

All scientific claims, interpretations, and responsibility for the final content rest solely with the human author.

## Image Attribution

All figures in this work were generated using Google Gemini (Nano Banana 2) at the explicit request of the author, based on conceptual descriptions derived from the theoretical frameworks presented herein. No figures were downloaded or adapted from third-party sources.

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## Conflict of Interest

The author declares no conflicts of interest.

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