Spatial Cell Theory: The Spatial Origin of Quantum Phenomena and a Unified Account of Randomness, Entanglement, Dark Energy, and More

Haihong Xie

Jilin University

Abstract

This study proposes a new ontological perspective for quantum mechanics: phenomena such as quantum wave-like behavior, randomness, and electron clouds may not be intrinsic properties of particles but originate from the structure of space itself. This perspective is founded on a re-examination of the formation mechanisms of electron orbitals and clouds. We particularly elucidate the origin of the "point-like randomness" exhibited by quantum entities, revealing that it is not an inherent property but stems from the dualistic structure of space and the inherent limitations of current observational technology.

This dualistic structure of space manifests as "Open Dimensions" and "Closed Dimensions." Present technology can only detect phenomena on the "Open Dimensions." When a quantum entity possesses low kinetic energy, it primarily moves within the "Closed Dimensions," becoming instantaneously detectable only when passing through an intersection point between the two dimensions; the statistical distribution of a vast number of such instantaneous events manifests as the electron cloud.

Based on this dualistic structure, the paper further deduces the fundamental unit of space—the "spatial cell"—and thereby constructs the "Spatial Cell Theory." The theory posits that space is woven from discrete "spatial cells." Each cell contains two functionally distinct dimensions: the "Open Dimensions" serve as connecting channels, linking cells to transmit matter, energy, light, and more; the "Closed Dimensions" do not participate in intercellular connections and serve as the primary arena for the motion of quantum entities with low kinetic energy. Within this framework, a wide range of physical phenomena—including the superluminal correlations of quantum entanglement, dark energy, dark matter, double-slit interference, quasars, and the microscopic dynamics of gravity—can be explained within a unified mechanistic framework.

Keywords: Spatial Cell Theory, Discrete Spacetime, Quantum Gravity, Open and Closed Dimensions, Spatial Ripples.

1 Introduction

1.1 The Origin of the Problem: The Ontological Dilemma of Electron Orbitals

Quantum mechanics faces an inescapable root problem: what is the physical essence of the "electron orbital" or "electron cloud"[1,2]? If regarded as an independent material entity, one must explain its discrete energy levels, perfect nuclear-centric nature, and even whether this necessitates defining an infinite variety of new particles. If attributed to some property of the

atomic nucleus, it becomes difficult to explain its non-local, probabilistic complex behavior. This paper is not satisfied with the instrumentalist stance of "shut up and calculate." To probe the ontological reality of the electron orbital, we step beyond the traditional quantum framework and boldly propose: the "electron orbital" is neither traditional matter nor a subsidiary attribute of the nucleus; what its essence ultimately points to is the very stage upon which particles exist—space. This study further reveals that a series of quantum phenomena (though not all), are essentially endowed by the structure of space, rather than being intrinsic properties of the particles themselves.

1.2 The Necessity of a New Path: Discrete Spacetime as the Physical Environment

The above considerations lead us to a revolutionary line of thought: what the electron cloud represents might be some intrinsic structure of the spatial environment in which the atomic nucleus resides. We therefore propose that space is not continuous but a physical network composed of discrete fundamental units—"spatial cells". Electrons do not move through a void; instead, they enter, exit, and wander within this discrete lattice of spatial cells.

What structure of a spatial cell could naturally give rise to the electron cloud phenomenon, which exhibits both "point-like randomness" and "spatial diffuseness"? We construct the core of the model through a crucial abductive inference: this phenomenon strongly suggests a functional duality within the spatial cell:

- There exists an internal network ("Closed Dimensions") that cannot be directly detected

by current observational means. It is the physical substrate for the probabilistic existence of electrons and their primary arena of motion.

- There exists a classical channel ("Open Dimensions") detectable by current observational means. Light or particles with sufficient kinetic energy propagate along this dimension.

- The Open Dimensions and the Closed Dimensions have intersection points.

These postulates regarding the Closed and Open Dimensions are remarkably simple yet possess astonishing explanatory power. We propose:

- The essence of an electron orbital is the dynamic picture of an electron leaving its current spatial cell and wandering among surrounding cells.

- An electron transition is the manifestation of an electron absorbing or releasing energy, thereby entering or leaving other spatial cells.

- The electron cloud can be explained as follows: an electron continuously jumps and shuttles among multiple spatial cells. Each observed localized electron is an instantaneous snapshot captured when the electron, moving within the "Closed Dimensions", arrives at an intersection point with the "Open Dimensions". The statistical distribution of a large number of such snapshots constitutes the electron cloud.

Even more encouragingly, this simple picture of space not only clearly explains electron behavior but also provides a unified explanatory framework for a host of fundamental physics puzzles, including the constancy of the speed of light, quantum entanglement, the nature of

gravity, and even cosmic expansion. This paper will proceed as follows: Section 2 will systematically elaborate the complete physical picture of the Spatial Cell Theory; Section 3 will demonstrate in detail how this model provides unified explanations for quantum phenomena, gravity, and cosmic expansion; Section 4 will discuss the integration with string theory and its significance; Section 5 will summarize the meaning of this theory, namely the four pillars of the cognitive reconstruction of physics it supports.

2. The Physical Picture of the Spatial Cell Model

This section will systematically elaborate the basic postulates and core concepts of the "Spatial Cell Theory". We will depict the ontological physical picture of this discrete space model in a manner independent of any specific physical phenomena.

Naturally, this model represents merely the simplest structure inferred from currently discovered physical phenomena and research findings, tracing back to their origins. It remains in a hypothetical state and is intended to provide a new avenue of thought for physics research.

2.1 The Discreteness of Spacetime and the Geometric Form of the Cell

The first principle of this theory is: space is not continuous, but composed of discrete fundamental units—"spatial cells"—that are interconnected at their vertices to form a dynamic network. This postulate directly challenges the traditional notion of continuous and smooth space in general relativity.

We argue that a regular octahedron (or its topologically equivalent sphere) is the simplest geometric configuration for constructing a flat three-dimensional spatial network. The features of this configuration are evident: its surface has 12 edges (or equivalent arcs), 6 vertices, and internally, it has three orthogonal axes (X, Y, Z). This choice is based on its advantages in spatial packing efficiency, isotropy, and the naturalness of orientation (it naturally defines three orthogonal directions).   As shown in Figure 1:
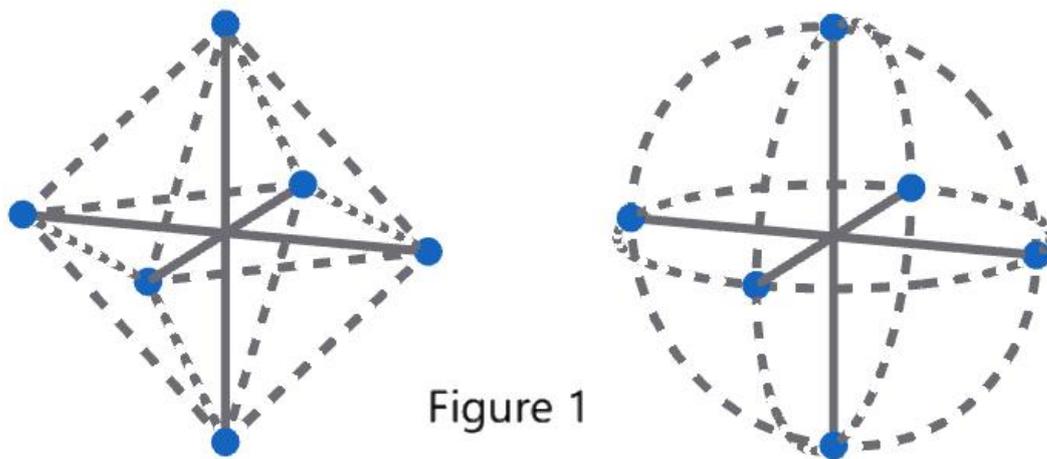

Figure 1

The two structures of spatial cells:
the regular octahedron and its topologically equivalent sphere.

The solid lines inside represent the Open Dimensions,
while the dashed lines on the surface represent the Closed Dimensions.

2.2 The Dual Functional Structure of the Cell: Open Dimensions and Closed Dimensions

The structure of the spatial cell embodies a functional duality, which serves as the geometric cornerstone of this model for explaining the diversity of the physical world. As shown in Figure 1, the internal solid lines represent the Open Dimensions, while the dashed lines on

the surface represent the Closed Dimensions.

2.2.1 Open Dimensions

The Open Dimensions refer to the three orthogonal axes (X, Y, Z) that run through the interior of the octahedral cell. They are the global channels constituting the continuity of space. They precisely connect with the Open Dimensions of adjacent cells at the cell vertices, thereby linking the entire universe's spatial cell network into a classical communication skeleton spanning macroscopic scales. Hence the term "Open Dimensions"—they are "open" to the entire universe, forming the public infrastructure through which matter and energy can propagate directionally in space.

Functionally, the Open Dimensions are the channels through which light, large particles, and any particle with kinetic energy can propagate directionally. They also constitute the classical physical stage directly perceivable by all current observational technologies. Although not a material structure themselves, they are strictly defined by the geometric symmetry of the spatial cells, manifesting as the classical attributes of continuity, locality, and clear causality exhibited by space at the macroscopic level.

2.2.2 Closed Dimensions

The Closed Dimensions refer to the twelve edges (or arcs) that form the stable surface of the octahedral framework. These edges (or arcs) interconnect within the cell, forming an internal support skeleton that maintains the cell's geometric configuration, but they do not directly

participate in connections between cells, hence the term "Closed Dimensions."

Functionally, the Closed Dimensions are the primary arena for particle motion. Quantum superposition, entanglement, and other non-local behaviors all occur within this supporting structure formed by these dimensions. Since all current observational technologies are based on the "Open Dimensions," the dynamical processes within the Closed Dimensions cannot be directly probed. Consequently, the true scene of quantum activity cannot be directly observed, which constitutes the origin of the apparent probability and randomness in quantum mechanics.

Furthermore, at the microscopic level, the Closed Dimensions exhibit an attractive effect on energy mediators, but their structure cannot retain an energy mediator for an extended period. This characteristic of continuous attraction but inability to retain, which will be discussed later, forms the microscopic dynamical basis for gravity.

Finally, when a spatial cell is compressed, its Closed Dimensions will directly connect with those of adjacent cells. This allows quantum particles to leap directly into neighboring spatial cells, bypassing the Open Dimensions.

2.3 Cell Connection and Energy Quantization: The Synapse

Spatial cells connect with neighboring cells through their 6 vertices. We define this connection point as a "synapse." The synapse is the sole channel and fundamental portal for

energy and information exchange between cells.

A core hypothesis is: the act of energy crossing a synapse is quantized. That is, each crossing must occur in terms of a most fundamental, indivisible minimum unit of energy. This property originates from the inherent, discrete physical structure of the synapse itself. Therefore, the transmission of energy through the spacetime network is naturally discrete, in packets. This provides the most direct spacetime-structural origin explanation for the phenomenon of energy quantization discovered by Planck.

Additionally, synapses are located on the Open Dimensions; the Closed Dimensions do not pass through synapses—meaning the intersection points of Closed and Open Dimensions are not the points of connection between cells. The slower propagation speed of the Open Dimensions compared to the Closed Dimensions might also be related to these synapses or nodes.

Clearly, the synapse hypothesis is inspired by the structure of neuronal synapses in the brain and is introduced to address the "energy quantization postulate." In reality, a synapse structure might not be necessary; the nodes between spatial cells themselves might enable energy quantization. This hypothesis merely provides a conceptual pathway, giving energy quantization a material basis for research.
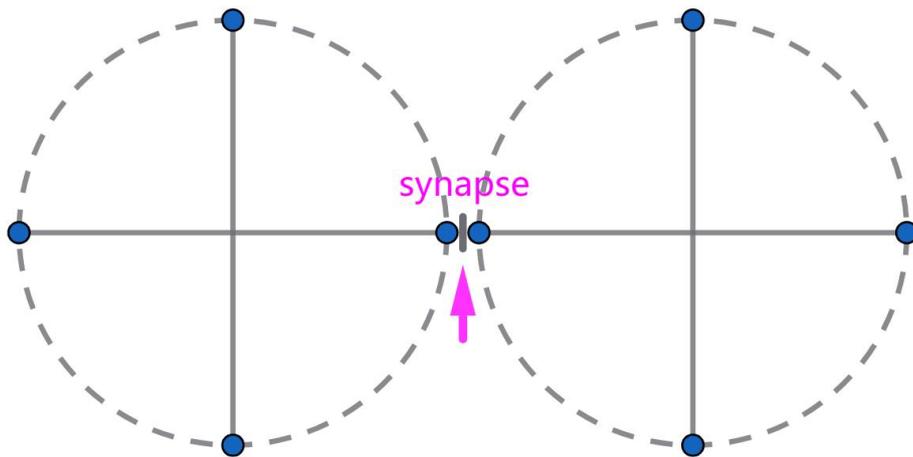
The synapse is shown in Figure 2:

Figure 2

The connection point between cells is hypothesized to be a synapse

2.4 The Basic Physical Property of Cells: Microscopic Elasticity

This model endows the spatial cell network with a fundamental physical property: microscopic elasticity. The "dimensions" constituting the network are not absolutely rigid; rather, like physical entities, they can be compressed, stretched, or twisted. This elasticity is an intrinsic property of the cell network. When elastic changes occur, elastic potential energy is generated. This is shown in Figure 3.
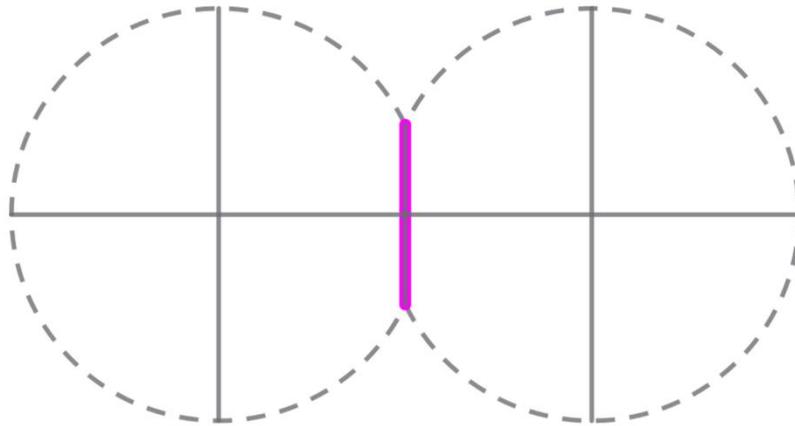
Figure 3

1. The purple line represents the region where two cells are compressed
2. When cells are compressed, the Closed Dimensions become connected

From this, we define the "compressed state" of the universal spatial network: it refers to the state where the entire universe's spatial cell network is under macroscopic compression. In this state, the network stores significant elastic potential energy. Furthermore, local regions of the network can also deform due to perturbations (e.g., from massive celestial bodies), manifesting as changes in cell density and tension.

It is worth noting that both Open and Closed Dimensions possess this microscopic elasticity, making the spatial elastic potential energy non-linear.

2.5 Spatial Ripples

At the microscopic scale, cosmic space is not absolutely static but possesses an intrinsic energy instability. This instability primarily targets and manifests within the "Open Dimensions," appearing as random, minute background energy fluctuations that persistently affect the classical channels of spatial cells. We term this phenomenon "spatial ripples." This
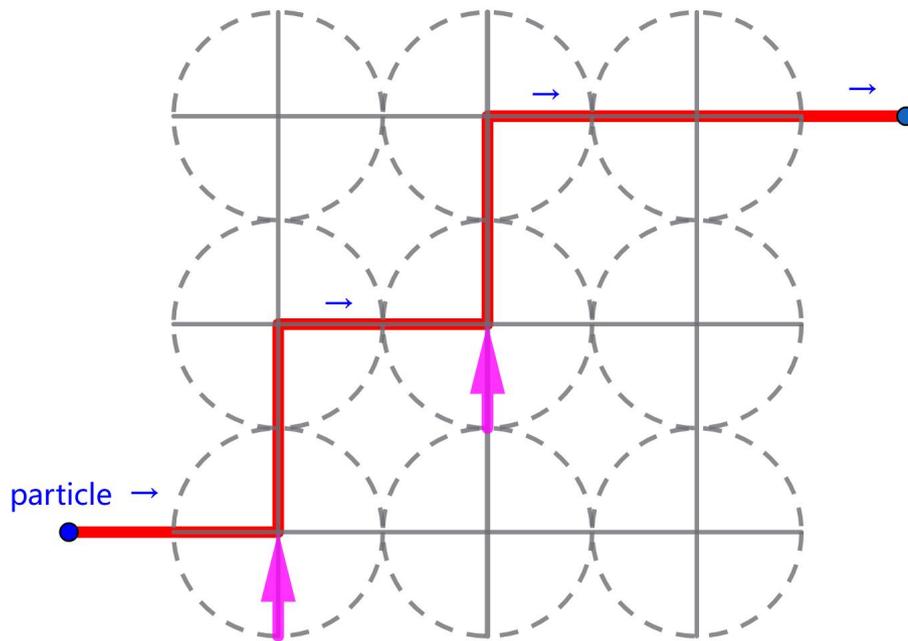
is shown in Figure 4.

Figure 4

1. The purple arrows indicate spatial ripples,
   which are responsible for the wave-like behavior of particles
2. The red trajectory represents the path of a particle
   under the influence of spatial ripples

Spatial ripples constitute the dynamical background of the classical spacetime skeleton. They exert continuous and random perturbations on particles moving within the "Open Dimensions." This ubiquitous microscopic disturbance is an important root cause for the random and probabilistic behavior exhibited by particles (like electrons) in directional motion.

It should be noted that the concept and effects of "spatial ripples" are primarily established based on the analysis of the "Open Dimensions," the observable classical channel. Whether similar or more complex background fluctuations exist within the "Closed Dimensions" is

beyond the scope of direct exploration by the current theoretical model and observational means, representing an open question for future research.

3. Unified Explanations Based on the Spatial Cell Model

In the previous section, we constructed a spacetime model based purely on geometric and mechanical principles. This section will argue that this seemingly simple, even rudimentary, physical picture is in fact a unified framework with immense explanatory power. Numerous physical phenomena, from microscopic quantum probability to the macroscopic fate of the cosmos, can be viewed as natural emergences of this foundational structure at different levels.

3.1 The Origin of Quantum Randomness and Wave-Particle Duality

The most perplexing features of quantum mechanics are its inherent randomness and wave-particle duality[1,2,3]. This model provides clear mechanisms for these.

● **Explanation of Electron Cloud and Localized Measurement**: The primary arena for particles like electrons is the "Closed Dimension" network. However, all our existing detection technologies can only interact with the "Open Dimensions," the classical channel. Only when a particle, moving within the Closed Dimensions, happens to arrive at a "node" (the intersection point of the two dimensions) connected to the Open Dimensions, can it interact with the detection medium and be recorded as a localized, particle-like measurement event. Therefore, the randomness exhibited by quantum

mechanics is not an intrinsic property of the particle itself, but stems from the fundamental limitations of our observational methods—it's as if we can only glimpse a continuous internal process through discrete, fixed "windows." Each "captured" particle is merely an instantaneous slice of its entire activity; the statistical distribution of a large number of such instantaneous slices constitutes the electron cloud.

- **Explanation of Matter Waves**: When a particle gains sufficient kinetic energy, its range of activity can extend into the "Open Dimensions" channel, thus exhibiting the particle-like nature of directional motion. However, its motion is continuously subjected to random perturbations from "spatial ripples", causing its path to deviate. The combination of such "directional motion" and "random deflection" for a large number of particles manifests statistically as wavelike behavior (interference fringes). The "wavelength" is determined collectively by the particle's mass, velocity, cell scale, and ripple intensity.

This is not difficult to understand; an analogy: an observer standing on a street cannot know the activities of people inside houses (motion within "Closed Dimensions"). Only when someone passes by a window or door (a "node") is their figure momentarily captured from the outside.

3.2 The Superluminal Correlation Mechanism of Quantum Entanglement

When the spatial cell network is in a "compressed state," the Closed Dimensions of adjacent cells interconnect, forming a global correlational background. In this state, the correlated

state of a pair of entangled particles is not maintained by signals transmitted through the Open Dimensions but is encoded within this already-connected Closed Dimension network. Measuring one particle influences the state of the other through coordination via the Closed Dimension network. Because the intrinsic propagation speed of the Closed Dimensions far exceeds that of the Open Dimensions (the channel for light speed), this coordination process manifests as "superluminal" correlation. A key testable prediction of this model is that once space exits the compressed state and the Closed Dimension network disconnects, this quantum entanglement phenomenon[4] based on spatial structure will vanish. As shown in Figure 5:
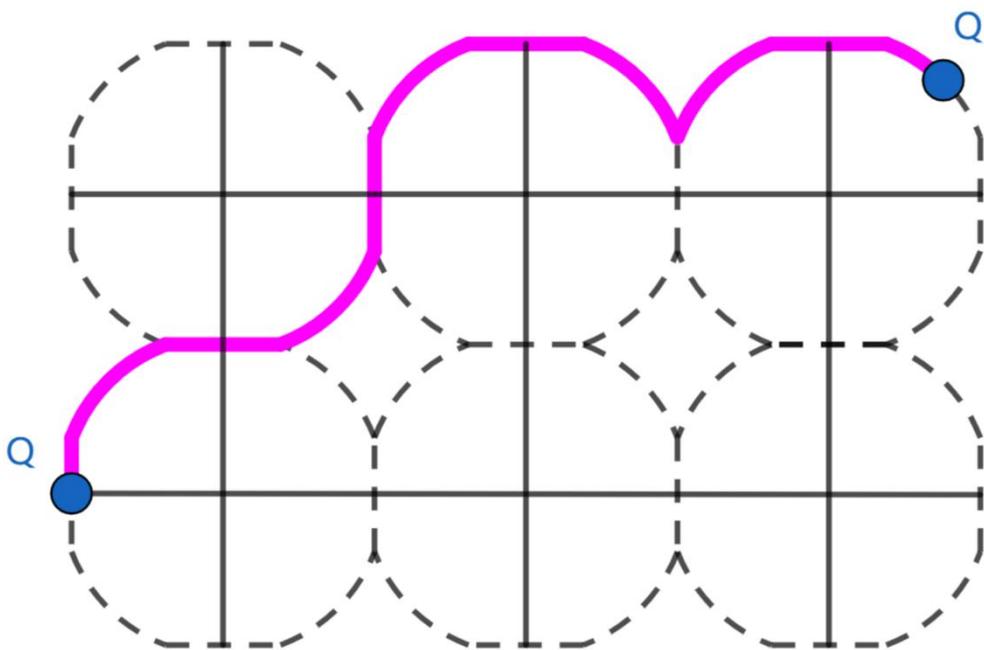

Figure 5

1. The purple trajectory indicates the pathway of quantum entanglement.
2. In the compressed state, spatial cells exhibit connected Closed Dimensions, enabling faster information transfer and permitting quantum entanglement to facilitate superluminal communication.

3.3 The Microscopic Essence of Gravity and Spacetime Curvature

General relativity interprets gravity as the geometric curvature of space[9]. This model reveals that beneath this geometric representation lies a more fundamental microscopic dynamical process. Clearly, a complete theory of gravity must simultaneously explain the following three interlinked core questions:

- Why does spacetime curve? (The essence of the phenomenon)
- Why does curved spacetime produce gravity? (The effect of the phenomenon)
- Why does gravity ultimately cause matter to cluster? (The result of the effect)

To this end, this work constructs the "Microscopic Dynamics of Gravity." Its core thesis is: Gravity is not a direct interaction between masses; its essence is a continuous, dynamic, and unequal competition between spatial cells (especially their Closed Dimensions) and matter for the most fundamental energy units (energy mediators). Note: we do not adopt the concept of a "graviton," but instead use the more primitive concept of the "energy mediator," as we believe current experiments and data are insufficient to infer what the true mediator of gravity might be. The specific mechanism is as follows:

3.3.1 The Essence of Spacetime Curvature: Network Deformation due to Competition

Spatial cells (especially the Closed Dimensions) themselves require energy, thus competing with matter for energy mediators. However, their structure dictates that they cannot store energy mediators, exhibiting a characteristic of "grabbing but not retaining"—they function

like a pump that can briefly seize but cannot hold onto energy mediators. This keeps spatial cells in a perpetual state of "hunger," engaging in continuous competition for energy mediators with matter, which serves as a stable "energy reservoir." This ubiquitous, matter-directed suction of energy mediators generates continuous tension within the elastic cell network. This tension, transmitted via the elasticity of space, ultimately leads to local deformation of the network—specifically manifested as a gradient change in cell density. The greater the mass of a celestial body, the more significant the deformation gradient in the surrounding network. Macroscopically, this geometric state of network deformation is what we observe as "spacetime curvature." Therefore, curvature is a natural outcome of microscopic dynamical competition, not a purely geometric postulate. This is shown in Figure 6:
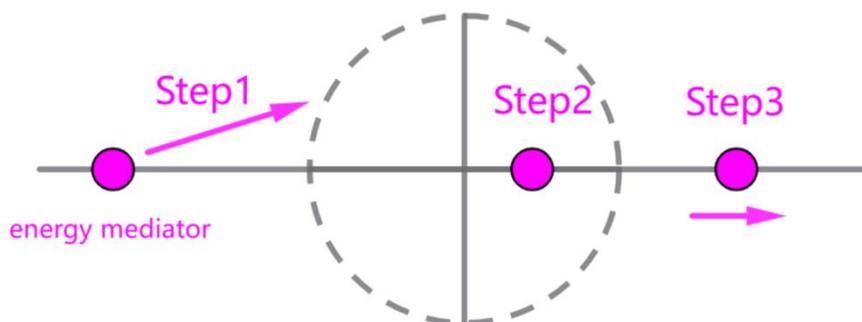

Figure 6

This diagram illustrates the microscopic dynamics of gravity:
Step 1: The energy mediator is pulled by the Closed Dimension.
Step 2: The energy mediator enters the spatial cell. However, as the cell's dimensions
      are inherently just channels, they cannot retain the mediator for an extended period.
Step 3: The energy mediator is ultimately captured by matter and leaves the cell.

3.3.2 The Generation of Gravity: Stronger Pull from High-Density Regions

The phenomenon that curved space produces gravity is easier to explain. The cells'

competition for energy mediators is not unidirectional. When an object moves through space, the surrounding spatial cells continuously tug at its energy mediators. Thus, even without curved space, this microscopic tugging itself constitutes the origin of gravity.

Near massive celestial bodies, due to the higher density of spatial cells, the microscopic tugging from that direction is stronger in net force and more concentrated in direction, manifesting macroscopically as a significant gravitational pull towards the mass center.

3.3.3 The Trend of Matter Clustering: Natural Aggregation Formed by Bidirectional Pulling

The trend for all matter to eventually cluster stems from the bidirectional action of spatial cells: the spatial cells located between two objects simultaneously exert a tugging on the energy mediators of both. This bidirectional microscopic pulling from the intermediate region has the net effect of pulling the two objects towards each other, ultimately driving the aggregation of matter.

In summary, once space itself is viewed as an active participant, the dynamical mechanism of gravity becomes this simple! Based on this clear microscopic picture, starting from the dynamics of "energy competition," one could in principle derive the fundamental equations of interaction at the cellular scale, whose macroscopic integrated form is expected to naturally reduce to Newton's law of universal gravitation.

3.4 Cosmic Accelerated Expansion and the Identification of Dark Energy

The observed accelerated expansion[6,7] of the universe is a direct manifestation of the dynamical properties of this model. The current universe's spatial cell network as a whole is in a "compressed state." According to Section 2.4, this state stores enormous elastic potential energy. It is precisely this intrinsic potential energy, permeating all spatial cells, that provides the repulsive force driving the accelerated expansion of the cosmos. Thus, the mysterious "dark energy" is identified as the intrinsic elastic potential energy of the spatial cell network.

It is also important to note that during cosmic accelerated expansion, the Closed Dimensions also possess elastic potential energy; it is not only the Open Dimensions at work. Consequently, the rate of change of the acceleration during cosmic accelerated expansion is not linear, but related to the deformation rate of the octahedron (or equivalent sphere).

3.5 Spacetime Phase Transitions and the Fate of Matter: A Dynamic Cyclic Universe Model

The elastic spacetime framework of this model naturally predicts that the spatial cell network can exist in three distinct macroscopic phases. This not only provides a unified explanation for the composition of the universe but also paints a picture of a dynamic, cyclic cosmos, simultaneously explaining the problem of dark matter[8].

The Three Phases of Spacetime and the Three States of Matter:

- **Compressed Phase:** The spatial cell network is in a compressed state, storing enormous

elastic potential energy. This potential energy manifests as the repulsive force driving cosmic accelerated expansion (i.e., dark energy). In this phase, the "Closed Dimension" network pathways remain open and stable due to compression, and quantum phenomena are active.

- **Normal Phase:** The network is in a stress-relaxed baseline state. At this time, the "Closed Dimension" pathways are interrupted. Matter located in such regions exhibits minimal quantum activity; physical and chemical processes scarcely occur. Quantum behavior is confined within the cell space, as if "frozen," revealing itself only through gravitational effects—this is the explanation for dark matter. Of course, the transition to the normal phase is not instantaneous; the Closed Dimensions recover first, followed by the Open Dimensions.

- **Stretched Phase:** The network enters a stretched state due to some mechanism (e.g., inertia following accelerated expansion leading to continued expansion). Contrary to the "Compressed Phase," the elastic potential energy stored in this state manifests as a gravity-enhancing effect, potentially driving the deceleration of cosmic expansion and ultimately a turn towards contraction. Clearly, in this state, only the Open Dimensions participate in the stretching.

3.5.1 Dynamic Cosmic Cycle: "The Breathing Universe"

These three phases together constitute a possible cosmic cycle mechanism: The universe begins accelerating expansion from a Compressed Phase. As expansion proceeds, network stress gradually relaxes, and some regions enter the Normal Phase (the proportion of dark

matter increases). After the overall dynamical evolution reaches a critical point, the universe may transition from expansion to contraction, entering a Stretched Phase. The contraction process eventually re-injects energy into the network, returning it to a Compressed Phase, preparing for the next cycle of expansion. The evolution of the universe might precisely be the eternal "rhythm of tension and relaxation" of the spatial cell network oscillating among "Compressed," "Normal," and "Stretched" states according to its elastic dynamics.

3.5.2 The "Spacetime Oasis" Hypothesis and Testable Predictions

Within this grand picture, our local region of the universe appears particularly special. The gravity of massive celestial bodies (like galaxies) can locally maintain a "Compressed Phase" environment in their vicinity, forming "spacetime oases" within the vast desert of the "Normal" universe. Within these oases, physical laws remain active, allowing life to flourish. This predicts that on galactic or massive celestial body scales, the distribution of dark matter (Normal Phase matter) should exhibit voids centered on these massive bodies, providing a clear basis for observational testing. For instance, is the Oort Cloud composed of dark matter? Or is the space beyond it filled with dark matter?

3.6 Explanation of Decoherence in the Double-Slit Experiment

The "decoherence" phenomenon in the double-slit experiment[5], where observation causes interference fringes to disappear, has long been shrouded in mystery. This model, based on the concept of "spatial ripples," provides a clear physical picture-based explanation. This is
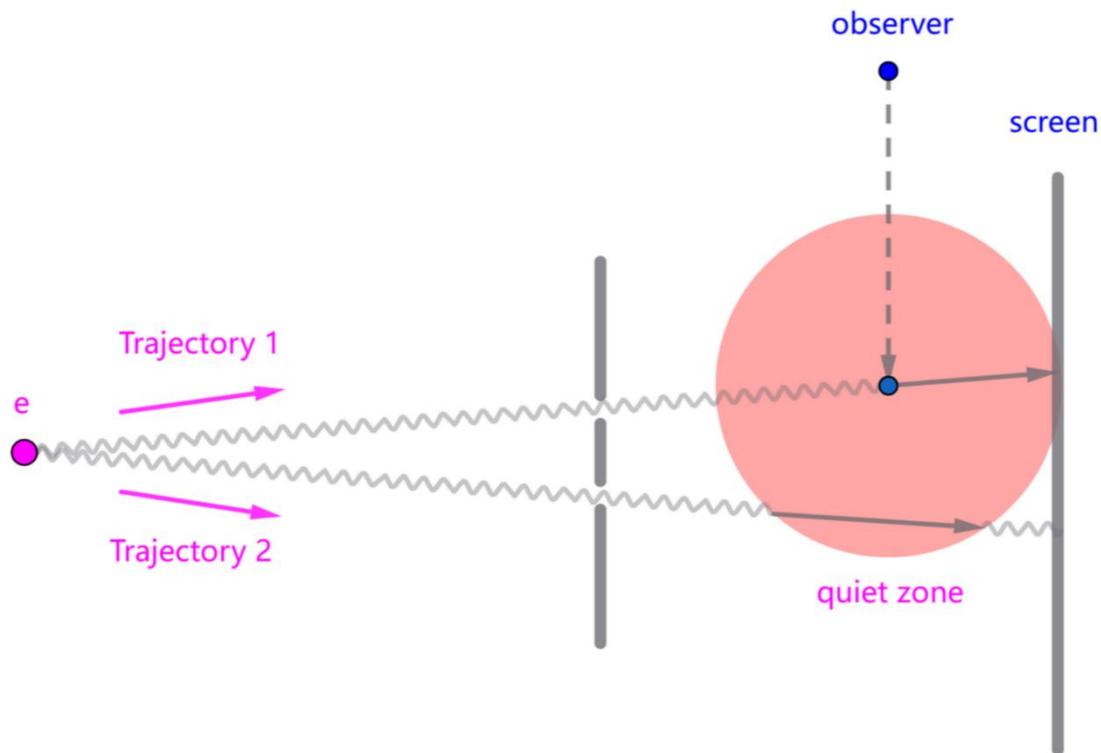
shown in Figure 7:

Figure 7

This diagram illustrates the principle of the double-slit interference experiment. During observation, a photon collides with the particle, creating a temporary quiet zone. Within this zone, spatial ripples cease to function, causing the particle to lose its wave-like behavior:

Trajectory 1: The particle propagates forward in a wave-like form. Upon observation, it collides with a photon, generating a quiet zone. The zone spans a relatively large area encompassing many spatial cells (not shown in the diagram). Within it, spatial ripples are suppressed, forcing the particle to travel in a straight line.

Trajectory 2: The particle propagates forward in a wave-like form. As it passes through the quiet zone, it temporarily loses its wave-like behavior and travels linearly. After exiting the zone, it resumes wave-like propagation.

3.6.1 Mechanism Explanation: Observation Creates a Temporary "Quiet Zone"

According to this model, when a particle (e.g., an electron) is "observed," it essentially undergoes a strong local interaction (collision) with a probe photon. The diffuse energy released in this process temporarily suppresses or cancels out the "spatial ripples" in that local position and the surrounding spatial cells. The effect is that, centered on the spatial cell where

the interaction occurs, all spatial cells within a spherical region of finite radius have their spatial ripples temporarily "cleared," forming a short-lived "quiet zone."

Within this "quiet zone," particles lose the physical environment (the spatial ripples) that causes them to exhibit wave-like behavior due to irregular perturbations. Therefore, any particle passing through this region, regardless of its specific path or whether it is directly observed, will temporarily exhibit a definite particle-like trajectory and cannot undergo interference. This is the microscopic essence of "decoherence" in this model.

3.6.2 Testable Predictions: Locality and Reversibility

Based on the above mechanism, this model leads to a strong prediction differing from traditional views:

- **Regional Effect**: A single local, strong observation will suppress wave-like behavior within a finite spatial region (much larger than the particle's path itself). This means that any particle passing through that region will lose its wave-like nature. Therefore, in a double- or multi-slit experiment, observing one slit could temporarily cause the interference fringes from adjacent slits to disappear.

- **Reversible Effect**: After a particle leaves this temporary "quiet zone," it is re-exposed to the ubiquitous "spatial ripples," and its wave-like behavior (ability to interfere) is restored.

- **Temporary Effect**: The "quiet zone" is temporary. Its duration is jointly determined by

the dynamics of collision energy dissipation and the self-recovery of the "spatial ripple" background.

This explanation transforms decoherence from an abstract issue of "information leakage" or "wave-function collapse" into a local, reversible physical process based on the microscopic dynamics of spacetime. The concept of spatial ripples also thoroughly demystifies the essence of quantum "superposition" and the "uncertainty principle": the wave-like nature of quantum particles is imparted by space, not an intrinsic property of the quantum itself; while spatial ripples themselves are uncertain, they can be temporarily counteracted.

3.7 Quasars and Massive Dark Matter Halos: A Unified Explanation Based on Spatial Cell Diversity

In the preceding chapters, we constructed a simplified model of the "spatial cell" based on the regular octahedron (or its topologically equivalent sphere) as the simplest geometric configuration. This model, with its clear functional duality (Open and Closed Dimensions), successfully provided unified explanations for quantum phenomena and classical gravity, laying a solid foundation for the theory.

However, just as the biological cells constituting complex life forms vary in morphology and function, the "spatial cells" constituting the fabric of cosmic spacetime, while adhering to the same basic principles, should also exhibit natural diversity in form and properties. When attempting to use the same standard "ideal cell" model to explain two extreme astronomical

phenomena—the intensely bright and active quasars and the almost non-luminous massive dark matter halos—we encounter a profound contradiction: both could be located in regions under a "compressed state" induced by massive celestial bodies, so why are their physical manifestations so vastly different? Especially according to the inference in Section 3.5, in regions of cellular "compressed state," theoretically there should not be large amounts of dark matter, which directly conflicts with the observed massive dark matter halos.

Therefore, we believe it is necessary to introduce diversity among spatial cells into the theory. While adhering to the core principle that "Closed Dimension connectivity determines quantum activity," we propose a new hypothetical distinction regarding cell morphology, aiming to unify the explanation for these two extreme cases: quasars and dark matter halos.

3.7.1 Quasars: Extreme Manifestation of High-Efficiency Connection Zones

The stability of a regular octahedral structure, besides the internal three orthogonal axes, requires only 12 edges on its surface to connect the vertices. However, nature might harbor cell morphologies with more complex and abundant connection structures. For example, their surfaces could have more edges beyond the basic framework, or their face structures might not be simple flat triangles but possess convex or complex topological features, giving them larger contact interfaces and more connection points with neighboring cells.

This work hypothesizes that astronomical objects like quasars, which possess extremely active galactic nuclei, reside in cosmic regions dominated by such "high-efficiency

connection-type" spatial cells. The Closed Dimensions of such cells inherently possess excellent connective capabilities. Even under conditions where the macroscopic "compressed state" is not extreme, they can form exceptionally unobstructed and dense microscopic networks. This maximizes the efficiency of quantum information exchange, energy transfer, and transformation in such regions, manifesting on the "Open Dimensions" as unimaginably high luminosity and activity. Quasars can be viewed as "spacetime oases" in the cosmos, composed of "super cells" where physical laws are most active.

3.7.2 Massive Dark Matter Halos: Gravitational Relics of Low-Efficiency Connection Zones

The standard regular octahedral configuration itself might precisely be a "low-efficiency connection-type" structure. Geometrically, it might require a relatively high global "compression degree" for its "Closed Dimensions" to form effective connections with neighboring cells. Its topologically equivalent sphere might be a more efficient connecting structure.

Therefore, we posit that galaxies or regions containing massive dark matter halos might be situated in spatial backgrounds primarily composed of such "low-efficiency connection-type" (regular octahedron) cells. Even under the macroscopic "compressed state" induced by galactic gravity, the inherent connection efficiency of the "Closed Dimensions" between such cells remains low, making it difficult to form an effective network supporting quantum activity. Matter residing within such regions has its quantum behavior deeply suppressed,

participating only gravitationally through its mass, thus manifesting as dark matter that emits almost no electromagnetic radiation. These regions constitute "silent deserts" within the "compressed state" cosmos.

3.7.3 Dark Matter Around Black Holes

Beyond the inherent morphology of cells, their dynamic deformation could also lead to loss of connectivity. For example, under the extreme gravitational gradient in the vicinity of a black hole, spatial cells might undergo intense tidal stretching, deforming from an octahedron into a spindle or needle shape.

In such a state, cellular connectivity might exhibit complex radial gradients: in the region closest to the black hole with the strongest stretching, cells might be extremely elongated along the gravitational direction, making it difficult for the Closed Dimensions of front and rear cells to connect end-to-end; however, lateral connections between adjacent cells at the same radius might still be partially maintained. In slightly more outer regions with weaker stretching, the deformation of cells might already be sufficient to obliterate all directional connection possibilities. Therefore, even in regions of extremely compressed space around a black hole, as long as cellular connectivity (whether due to inherent morphology or dynamic deformation) is disrupted, conditions for dark matter distribution can still arise.

In summary, this chapter, primarily addressing the cause of dark matter, deduces that spatial cells may exist in different morphologies and structures. Their essence stems from the same

core viewpoint: if the "Closed Dimension" network cannot effectively connect due to the inherent morphology or dynamic deformation of cells, quantum activity in that region will be "frozen," leading to the manifestation of matter as dark matter.

3.8 Preliminary Unification of Other Physical Phenomena

- **Constancy of the Speed of Light**: The speed of light is the inherent speed limit for electromagnetic waves propagating through the rigid skeleton of the "Open Dimensions," determined by the fundamental properties of the Open Dimensions, and thus constant in all reference frames.

- **Energy Quantization**: As described in Section 2.3, the natural quantized property of energy exchange through "synapses" provides the most fundamental spacetime-structural explanation for the phenomenon of energy quantization discovered by Planck and Einstein.

4. Integration with String Theory: Strings as the Fundamental Material Composing Spatial Cells

To construct a complete theory, one must answer in what physical form particles are transmitted and interact within the "Open Dimensions" and "Closed Dimensions." Any simplistic view of "dimensions" as smooth pipes or mechanical tracks cannot explain the origin of particles' intrinsic properties (like mass, spin).

On this critical issue, we deeply integrate this model with string theory and propose a core assertion: Strings are the fundamental material composing spatial cells.

Specifically, open strings weave the Open Dimensions of the cells, while closed strings weave the Closed Dimensions. Thus, particles and their interactions can be understood as specific vibrational modes on these fundamental strings.

It must be emphasized that this correspondence is heuristic and principled. It aims to provide a solid and insightful physical picture for the microstructure and dynamics of spatial cells, not a strict terminological conversion. This integration not only injects microscopic dynamics into this model but also provides string theory itself with a long-missing, background-independent image of spacetime construction.

5. Conclusion

This paper systematically proposes the "Spatial Cell Theory." This is not merely the introduction of a new model but a large-scale cognitive reconstruction of the foundations of physics. Its core lies in a fundamental paradigm shift: redirecting the research focus from "physical entities evolving within a spacetime background" to "spacetime itself as the physical entity". We reconstruct spacetime as a dynamic network woven from discrete "spatial cells." The dual function of its "Open Dimensions" and "Closed Dimensions" provides a unified and mechanism-clear physical picture for a host of puzzles ranging from quantum phenomena to the fate of the cosmos.

This paradigm shift is supported by the following four theoretical pillars:

5.1 The Innovation of Spacetime View: From Geometric Background to Competitive Arena

The essence of spacetime is a dynamic network composed of spatial cells. The origin of gravity is not the passive response of spacetime to matter, but rather the continuous, dynamic competition between spatial cells (especially their Closed Dimensions) and matter for energy, characterized by "grabbing but not retaining". This competition leads to network deformation and density gradients, whose macroscopic representation is spacetime curvature.

5.2 Clarification of the Quantum Essence: From Probability Fog to Limited Observation

The probability and uncertainty of the quantum world stem from the fundamental limitations of our observational methods. The primary arena for particles (like electrons) is the Closed Dimension network of spatial cells. Their true dynamical processes cannot be detected by current technology. We can only perform a "particle-like" instantaneous observation on a particle when it moves to a node where the Closed and Open Dimensions intersect. The statistical distribution of a large number of such observations constitutes the electron cloud.

5.3 Upgrading the Path to Unification: From Unifying Forces to Exploring the Meta-Properties of Spatial Cells

This model reveals that the traditional pursuit of "unifying the four fundamental forces" is not the ultimate goal of physics. A more fundamental path lies in exploring the basic properties of spatial cells. All forces and material phenomena will be explained in a unified manner as natural emergences of this microscopic spacetime structure. Perhaps only when we have thoroughly understood the basic properties of spatial cells can we claim to have truly begun our exploration and understanding of physics.

5.4 Integration with String Theory: From Background Dependence to Spacetime Construction

This model integrates with string theory on a principled level, proposing a core assertion: strings are the fundamental material composing spatial cells. In particular, open and closed strings are interpreted as the fibers weaving the "Open Dimensions" and "Closed Dimensions" of spatial cells, respectively. This provides string theory with its long-missing, background-independent physical picture—strings are not merely vibrational modes for describing particles and forces; they themselves are the fundamental entities constituting spacetime.

In summary, the "Spatial Cell Theory" constructs a new, internally consistent framework that takes spacetime itself as the object of study. Starting from a set of simple geometric and dynamical postulates, it provides unified and mechanism-clear explanations for numerous puzzles from quantum mechanics, gravity to cosmology, and points the way for future exploration of the microstructure of spacetime.

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