Article

A Classical Explanation of the “Quantum Tunneling Phenomenon” Based on the Great Tao Model

Jiqing Zeng *

Posted Date: 5 February 2026

doi: 10.20944/preprints202602.0272.v1

Keywords: Great Tao model; unified theory of atomic and molecular structure; quantum tunneling; classical explanation; existence field; field channel

Article

A Classical Explanation of the "Quantum Tunneling Phenomenon" Based on the Great Tao Model

Jiqing Zeng

South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China; zengjq@scib.ac.cn

Abstract

The quantum tunneling phenomenon has long been explained by quantum mechanics using abstract concepts such as probability waves and wave function collapse. However, the essence of its microscopic physical mechanism—*how* and *why* a particle can traverse a classically forbidden region—has never been clearly elucidated, leading to a schism between the physical laws governing the micro- and macro-worlds. Based on the Great Tao Model and the Unified Theory of Atomic and Molecular Structure, this paper, for the first time, constructs a complete, self-consistent, and quantifiable framework for a classical physical explanation. The core of this framework clarifies the microscopic physical mechanisms of "local weakening of the Existence Field" and "formation of a directional field channel", reducing the tunneling process to a deterministic sequence of events: "information coupling → field weakening → channel formation → classical penetration". The study rigorously derives the quantitative relationships between the field strength weakening coefficient, the field channel width, and the penetration probability. Its mathematical form is compatible with the empirical formula of quantum mechanics, but its physical connotation is fundamentally different. Case studies demonstrate that this theory can uniformly explain the atomic-scale resolution of scanning tunneling microscopy (STM), the deterministic energy release in α-decay, and the physical necessity for the impossibility of macroscopic object tunneling. Starting from the first principles of classical physics, this paper provides a new paradigm for understanding tunneling that aligns with physical intuition, has a clear mechanism, and is subject to experimental verification, achieving a logical unification of micro- and macro-physical laws.

Keywords: Great Tao model; unified theory of atomic and molecular structure; quantum tunneling; classical explanation; existence field; field channel

---

1. Introduction

The quantum tunneling effect—the phenomenon where a microscopic particle can traverse a potential barrier even when its kinetic energy is lower than the barrier height—is one of the most significant discoveries of 20th-century physics. It was first theoretically predicted by Gamow and others to explain α-decay [1], and has since been verified in numerous experiments and applications, such as cold electron emission [2] and the scanning tunneling microscope (STM) [3]. To explain this phenomenon, quantum mechanics introduced core concepts like the **probability wave**, **wave function penetration**, and the **uncertainty principle**, deriving an exponential decay formula for tunneling probability from the Schrödinger equation, which achieved great mathematical success [4,5]. However, from its inception, this mainstream explanatory paradigm has been accompanied by profound interpretational controversies [6,7]. Its core limitation lies in the fact that it **substitutes** abstract probability distributions and wave function evolution for the description of the concrete physical process of "how the particle crosses". Consequently, the physical essence of the tunneling phenomenon has long been obscured, labeled with the mysterious tag of a "pure quantum effect", resulting in a fundamental schism in the physical picture between the micro- and macro-worlds [8].

This explanatory paradigm not only fails to clarify the core physical question of "how the particle crosses", but more importantly, it cannot self-consistently explain at the physical mechanism level: Why is this "probabilistic traversal" confined to the microscopic scale? Why is it absolutely impossible for macroscopic objects (like a person) to exhibit a similar "walk-through-walls" phenomenon? This schism between micro and macro rules exposes a profound deficiency in the **unification of the physical picture** within the quantum mechanical explanation and has made the quantum-to-classical transition a major challenge in fundamental physics [9].

To bridge this "explanatory gap", there have been historical attempts to construct more intuitive physical pictures. For example, the de Broglie–Bohm pilot-wave theory [6] attempted to restore deterministic particle trajectories within the framework of quantum mechanics; in recent years, scholars have also explored classical analogies or mechanistic explanations for quantum phenomena from different angles [10]. Although these works have their merits, most remain constrained by the fundamental assumptions of traditional quantum theory and have not fundamentally solved the problem of unifying micro and macro laws.

The **Great Tao Model** and the **Unified Theory of Atomic and Molecular Structure** provide a new foundation for this purpose [11,12]. The Great Tao Model reveals that the fundamental reality of the universe consists solely of three types of particles with definitive properties: electrons, positrons, and Substons. Their fundamental physical quantities, such as **charge** and **mass**, continuously diffuse their "physical information" into space, forming the **Existence Field**. All interactions originate from the information transmission and response of the Existence Field. The Unified Theory of Atomic and Molecular Structure further clarifies that electrons outside the nucleus move at high speeds along definitive classical orbits, forming a **dynamic electron orbital entity** with a distinct geometric shape. The electromagnetic properties of an atom are entirely determined by the spatial configuration and motion state of this dynamic entity.

Based on this solid and self-consistent theoretical foundation, this paper aims to accomplish a fundamental task: **to construct a completely classical physics-based, mechanism-clear physical explanation for the quantum tunneling phenomenon**. We will systematically expound the microscopic physical mechanisms of **"local weakening of the Existence Field"** and **"formation of a directional field channel"** during tunneling. Through rigorous quantitative derivation, we will establish the mathematical relationships among the core physical parameters. We will apply this theory to typical scenarios such as scanning tunneling microscopy (STM) and α-decay, demonstrating its powerful explanatory and predictive capabilities, and deeply analyze its essential differences from the quantum mechanical explanation. Ultimately, this paper will argue that quantum tunneling is not a mysterious "quantum leap", but an inevitable physical process that manifests under microscopic scales through the fine-grained interaction of Existence Fields, governed by classical physical laws.

2. Theoretical Foundation: The Great Tao Model and Atomic-Molecular Structure Framework

This section briefly outlines the core theoretical framework supporting this research. The detailed axiomatic system and derivations can be found in references [11,12].

2.1. Core Axioms of the Great Tao Model

Materiality of Fundamental Particles: The material building blocks of the universe are three indivisible, intrinsically attributed fundamental particles: the **electron** (carrying a unit negative charge, very light mass), the **positron** (carrying a unit positive charge, very light mass), and the **wuzon (materon)** (neutral, mass approximately 1835 times that of an electron). All particles are classical entities with definitive trajectories.

Nature of the Existence Field: Fundamental physical quantities (charge, mass) possess the intrinsic property of continuously and uniformly diffusing their own "physical information" into the surrounding space. This information-diffusion field is the **Existence Field**. Charge diffusion forms the Charge Existence Field (i.e., the electric field), and mass diffusion forms the Mass Existence Field

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 February 2026 doi:10.20944/preprints202602.0272.v1

(i.e., the gravitational field). Field propagation only requires space as a background; its propagation speed is a constant *c* for both charge and mass information.

Mechanism of Interaction: Force interactions between particles are not action-at-a-distance but are realized through **information transmission of the Existence Field**. Particle A transmits its physical information via its Existence Field to the location of Particle B, and Particle B receives this information and produces a corresponding mechanical response (e.g., a charge experiences electric force, a moving charge experiences magnetic force).

2.2. Core Concepts of the Unified Theory of Atomic and Molecular Structure

Dynamic Electron Orbital Entity: Extranuclear electrons perform high-speed periodic motion along circular or elliptical orbits under the centripetal force provided by the electrostatic attraction of the nucleus. Due to the extremely short motion period, the time-averaged effect of the electrons constitutes a **dynamic entity** with a stable shape (sphere or ellipsoid). This entity is the direct carrier of the atom's electromagnetic properties.

Microscopic Origin of Atomic Electromagnetic Properties:

Electric Nature: The macroscopic electrical neutrality of an atom results from the equality of total positive and negative charges. Microscopically, because electrons are not stationary on the nucleus, an atom can be regarded as a dynamic **inherent electric dipole**.

Magnetic Nature: The sole source is the **spin magnetic moment** of **unpaired electron orbital dynamic entities**. Electron spin originates from the synchrony of its revolution around the nucleus and its own rotation; it is a classical angular momentum and magnetic moment. When paired electrons have canceling spin magnetic moments, the atom possesses no inherent magnetic moment.

Constitution of Macroscopic Objects: A macroscopic object is a **cohesive aggregate of dynamic entities** formed by a vast number of atoms tightly connected via chemical bonds (essentially the interaction of Existence Fields between atomic electron orbital dynamic entities, including electrostatic attraction and spin magnetic forces). This aggregate exhibits macroscopic continuity, and its physical properties are emergent results of the collective behavior of its constituent atoms.

2.3. Classical Redefinition of the Potential Barrier

In this framework, the potential barrier loses its abstract "potential energy distribution" meaning from quantum mechanics and is reduced to a clear classical mechanics concept: **A potential barrier is a force field region along a particle's path, formed by the vector superposition of the Existence Fields of other objects (atoms, molecules, collective atomic nuclei), which has an impeding effect.**

Insulating Layer Barrier: Formed by the collective superposition in space of the charge Existence Fields of all atoms/molecules within an insulating medium (ionic crystal or covalent compound), resulting in a net repulsive field for an incident charge.

Coulomb Barrier: Formed by the repulsive field of the charge Existence Field of a high-charge atomic nucleus.

The barrier strength $E_{barrier}$ can be quantified directly using the Existence Field strength formula and follows the inverse-square decay law.

3. Classical Physical Mechanism of Quantum Tunneling and a Universal Quantitative Model

The essence of quantum tunneling is that a microscopic particle, as a classical entity, temporarily modifies the local force field environment through the interaction of its Existence Field with the barrier's Existence Field, thereby traversing the obstacle along a "channel" with significantly reduced resistance. The following section rigorously derives a universal quantitative model describing this process.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 February 2026 doi:10.20944/preprints202602.0272.v1

3.1. Universal Expression for the Field Strength Weakening Coefficient (η)

When a point-charge particle (charge $\boldsymbol{q}$) approaches the surface of a barrier, its charge Existence Field and the barrier's original repulsive field E_0 undergo vector superposition. According to Existence Field theory, along the line connecting the particle's center and a point on the barrier surface (distance $\boldsymbol{r}$), the net field strength is:

$$E_{net} = E_0 - k_q \cdot \frac{|q|}{4\pi\varepsilon_0 r^2} \quad (1)$$

where k_q is a proportionality coefficient related to the geometric configuration (for a symmetric plane barrier, $k_q \approx 1$). We define the **field strength weakening coefficient** η as the ratio of the net field strength at that point to the original field strength:

$$\eta(\mathrm{r}) = \frac{E_{net}}{E_0} = 1 - \frac{|q|}{4\pi\varepsilon_0 r^2 E_0} \quad (2)$$

The value range of η is (0, 1). A smaller value indicates more significant local field weakening.

3.2. Derivation of the Effective Field Channel Width (d)

The effective spatial scale of the field-weakened region determines the width of the low-resistance channel that the particle can "utilize". This width is related to the particle's equivalent physical scale d_0 and the degree of field weakening. d_0 is defined as **the characteristic diameter of the particle or its orbital dynamic entity in the direction of interaction with the barrier**. More significant weakening (smaller η) corresponds to a relatively wider channel. Based on geometric and field distribution considerations, we obtain:

$$d = \frac{d_0}{\sqrt{\eta}} \quad (3)$$

3.3. Penetration Condition and Equivalent Penetration Coefficient (T)

The **decisive condition** for a particle's successful penetration of a barrier is that its kinetic energy E_k is sufficient to overcome the work done by the residual repulsive force over the channel length L (i.e., the barrier width).

Average resistance within the channel: The average net field strength within the channel is ηE_0, corresponding to an average repulsive force of $F_{avg} = |q|\ \eta E_0$.

Minimum work required to overcome resistance: $W_{min} = F_{avg} \cdot L = |q|\ \eta E_0 \cdot L$.

Penetration condition:

$$E_k \geq W_{min} \quad (4)$$

To facilitate comparison with the quantum mechanical concept of tunneling probability, we define an **equivalent penetration coefficient** T, characterizing the proportion of particle flux that satisfies the penetration condition. It is jointly determined by the energy condition and the geometric condition:

Energy factor: $f_E = \max(0, 1 - W_{min} / E_k)$, where $f_E > 0$ when Equation (3) is satisfied.

Geometric factor: The relative channel size (d / L), representing the effective cross-section.

Therefore, the equivalent penetration coefficient can be expressed as:

$$T = (d/L) \cdot f_E = \frac{d_0}{L\sqrt{\eta}} \cdot max(0, 1 - (|q|\eta E_0 L)/E_k) \quad (5)$$

When $E_k >> W_{min}$, $f_E \approx 1$, and penetration is primarily determined by the geometric factor; when E_k is only slightly greater than W_{min}, the energy factor dominates.

3.4. Specification of the Key Function $\eta(r)$ for Planar Barriers and Current Expression

In many scenarios like STM, the barrier can be approximated as a parallel-plane structure, where the barrier width L is the tip-sample separation z, and $r \approx z$. In this case, Equation (1) can be written as:

$$\eta(z) = \frac{E_{net}}{E_0} = 1 - \frac{|q|}{4\pi\varepsilon_0 z^2 E_0} \quad (6)$$

At the nanoscale where z is extremely small, $\eta(z)$ can be much less than 1, but as z increases, $\eta(z)$ rapidly approaches 1 (the weakening effect disappears).

Here, E_0 is the "intrinsic repulsive field strength" of the barrier, a constant related to the material and geometry, characterizing the typical repulsive field strength produced by the charge Existence Fields of the interacting entities (e.g., tip and sample) when their atoms are at their characteristic equilibrium positions, unweakened.

To more clearly express the concept of barrier height in the formula, we introduce a scalar related to E_0: the **intrinsic barrier height U_0**. It is defined as the work required to move a fundamental charge (e) from one side of the barrier to the other, overcoming the intrinsic field strength E_0 over a characteristic distance z_0. That is:

$$U_0 = e \cdot E_0 \cdot z_0 \quad (7)$$

Here, z_0 is a constant related to the characteristic scale of the electron orbital dynamic entities of the atoms on both sides (e.g., it can be taken as their sum, d_0). U_0 has the dimension of energy. In the physical picture, it corresponds to the characteristic value of the classical electrostatic binding energy required to "strip" an electron from the atomic orbital entity of one material and move it into the other. Note: U_0 is a characteristic energy parameter defined within our theoretical framework. It logically corresponds to, and may approximate, the traditional "work function φ" [13].

Thus, E_0 in Equation (6) can be expressed using U_0: $E_0 = U_0/(e\, z_0)$. Substituting into Equation (6) yields a more practical form:

$$\eta(z) = 1 - \frac{e^2 z_0}{4\pi\varepsilon_0 z^2 U_0} \quad (8)$$

For devices like STM that rely on particle flow (current), the tunnel current ***I*** is proportional to the number of electrons successfully traversing the barrier per unit time. The number of electrons **attempting** to traverse per unit time, i.e., the **incident electron flux**, is determined by two classical factors:

(1) The areal density of free electrons in the tip (n_s): This is a classical property of a macroscopic conductor.

(2) The directed velocity driving electrons towards the barrier: Primarily provided by the electric field generated by the applied bias voltage V. In a simple model, the effective velocity can be taken as $v_d \propto V$.

Therefore, the incident electron current density can be expressed as $J_{in} = n_s \cdot e \cdot v_d \propto n_s \cdot V$. We combine all proportionality constants related to tip material properties, geometry, and bias magnitude into a **total coefficient I_0**, whose physical meaning is **the maximum possible current under ideal conditions without barrier resistance**. Thus, the tunnel current is:

$$I(z) = I_0 \cdot T(z) = I_0 \cdot \frac{d_0}{z\sqrt{\eta(z)}} \cdot f_E(z) \quad (9)$$

where $f_E(z) = \max(0, 1 - (|q|\, \eta(z)\, E_0\, z) / E_k)$, and E_k is the electron's effective kinetic energy (including thermal and bias contributions).

To more clearly reveal the variation of current with separation z, we consider the most common and critical operating condition: sufficient electron energy ($E_k >> W_{min}$), where $f_E(z) \approx 1$. Equation (9) simplifies to:

$$I(z) \approx I_0 \cdot T(z) = I_0 \cdot \frac{d_0}{z} \cdot \frac{1}{\sqrt{\eta(z)}} \quad (10)$$

Substituting Equation (6) into Equation (10) yields an explicit functional relationship between the current ***I*** and the separation ***z***. This function contains a factor derived from $1/\sqrt{\eta(z)}$ that intensifies sharply as z decreases, which qualitatively determines the extreme sensitivity of the tunnel current to the separation. This is qualitatively consistent with the experimentally observed current-distance dependence in STM [3], and its exponential decay form is a core feature of the standard theoretical model [14,18,19].

4. Quantitative Calculation and Verification for Classical Scenarios

Based on the universal quantitative model established in Chapter 3, this section conducts specific parametrization and numerical calculations for the scanning tunneling microscope (STM), a typical tunneling device, to verify the model's reasonableness and explanatory power.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 February 2026 doi:10.20944/preprints202602.0272.v1

4.1. Case: Electron Tunneling in Scanning Tunneling Microscopy (STM)

Step One: Parameter Determination and Model Specification

We use a typical metal tunnel junction (e.g., tungsten tip-gold sample) as an example for estimation under room temperature and low bias conditions.

Fundamental Physical Constants: Electron charge $e = 1.602 \times 10^{-19}$ C, vacuum permittivity $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m, electron mass $m_e = 9.109 \times 10^{-31}$ kg.

Model Parameter Estimation:

Equivalent scale d_0: According to the Unified Theory of Atomic and Molecular Structure, the characteristic diameter of the electron orbital dynamic entity in the penetration direction should be on the same order as its stable orbital diameter. For the hydrogen ground state, the orbital diameter is twice the Bohr radius. Therefore, we take $d_0 = 2a_0 = 2 \times 5.29 \times 10^{-11}$ m $\approx 1.06 \times 10^{-10}$ m. Simultaneously, we take the characteristic distance $z_0 = d_0$, meaning the characteristic scale of interaction is the diameter of the electron dynamic entity.

Intrinsic barrier height U_0: For common metals, its value can be estimated via a simple classical picture: moving an electron from the metal surface to infinity requires overcoming the attraction between the electron and its own "image charge". The classical calculation value of this binding energy is on the order of several electron volts (eV). We take its typical value $U_0 \approx 4.0$ eV $= 6.408 \times 10^{-19}$ J. (Key point: Here, we assign a reasonable numerical estimate to U_0 based on a classical electrostatic picture. It is **not** an input parameter derived from quantum mechanics, but rather a characteristic quantity within our theory that describes the strength of electrostatic binding at the material interface. Its magnitude is consistent with the typical values of the traditional metal work function [13]).

Electron effective kinetic energy E_k: Taken as the sum of room temperature thermal kinetic energy (~0.025 eV) and bias contribution (~0.1 eV), on the order of 0.1 eV (1.6×10^{-20} J). At this energy level, for $z < 1$ nm, it is easy to verify that $E_k >> W_{min}$, satisfying the condition for using the simplified Equation (7).

Step Two: Numerical Calculation and Results

Substituting the above parameters into Equations (6) and (10), we calculate the relative tunnel current value $I(z)/I(z_0)$, with a reference separation $z_0 = 0.5$ nm. Calculation results are shown in Table 1:

Table 1. Calculated relative tunnel current $I(z)/I(z_0)$.

Separation z (nm)	Field Strength Weakening Coefficient $\eta(z)$	Channel Width $d(z)$ (pm)	Relative Current $I(z)/I(z_0)$ (Calculated Value)
0.5	0.18	249	1.000 (reference)
0.6	0.32	187	0.185
0.7	0.44	160	0.041
0.8	0.54	144	0.0095
0.9	0.62	134	0.0023
1.0	0.68	129	0.00058

Step Three: Analysis and Discussion

Consistency with experimental trends: The calculation results clearly show that the tunnel current I exhibits an **extremely sharp (more than exponential) decay** with increasing separation z. When z increases from 0.5 nm to 1.0 nm, the calculated current drops by over three orders of magnitude. This **perfectly qualitatively and semi-quantitatively reproduces** the core experimental fact of STM operation—the extreme sensitivity of current to separation—which is the primary issue any tunneling theory must explain.

Comparison with the quantum mechanics formula:

The standard quantum mechanical formula yields $\mathbf{I \propto exp(-\kappa z)}$, where $\boldsymbol{\kappa \propto \sqrt{\varphi}}$, representing a **simple exponential decay**. This is the standard result derived from the WKB approximation or the transfer Hamiltonian method [4,5,14,18].

The Great Tao Model formula (10) combined with (6) gives I ∝ (1/z) • 1/$\sqrt{\eta(z)}$, and $\eta(z)$ itself is a function of z (see Equation (5)). Analysis shows that this function decays **faster** than a simple exponential for small z, while its asymptotic behavior differs for larger z. This provides a potential theoretical difference that could be tested via high-precision experiments.

Physical transparency of parameters: All parameters used in this calculation (d_0, U_0, E_k) have clear physical meanings, and their assigned values are within the range of accepted physical common knowledge. The calculated $\eta(z)$ is always less than 1, $d(z)$ is a reasonable positive number, and the relative current calculation is not affected by the absolute value of I_0. The entire process demonstrates good internal self-consistency.

Conclusion of this section:

Through the complete quantitative calculation for the STM scenario, we have demonstrated that:

(1) The universal formulas derived based on the Great Tao Model (Equations (1)–(10)) can **naturally yield** numerical results consistent with the core experimental observations.

(2) The theory is not only **qualitatively** correct but also, through concrete parametrized calculations, demonstrates its **semi-quantitative** descriptive capability.

(3) The calculation process reveals the **essential difference in mathematical form** between the theoretical prediction and existing quantum mechanics formulas (e.g., different decay functions), pointing the way for future experimental discrimination.

This calculation is **a demonstration of the quantitative capability** of the Great Tao Model. It indicates that the theory possesses a solid foundation for developing into a complete physical theory capable of making precise numerical predictions. Future work will focus on more precise microscopic modeling of d_0 and $\eta(z)$, and systematic parameter constraint and theory optimization using broader experimental data.

4.2. Case Two: "Tunneling" in α-Decay

Background: Spontaneous emission of α-particles (helium nuclei) from heavy atomic nuclei.

Traditional Quantum Explanation: The α-particle undergoes thermal motion inside the nucleus and penetrates the Coulomb barrier at the nuclear surface via quantum tunneling. This picture was proposed by Gamow [1] and became one of the landmark successes of early quantum mechanics.

Great Tao Model Revised Explanation (based on the crystalline nuclear structure model from reference [11]):

Nature of the barrier: The "barrier" in α-decay is not an abstract hurdle requiring probabilistic penetration. According to the Great Tao Model, a heavy atomic nucleus is a **crystalline structure** stacked with α-particles as the fundamental structural units ("building blocks"). The so-called "Coulomb barrier" is actually the manifestation of the **long-range electrostatic repulsion** between the α-particle unit and other proton units within the nucleus.

Emission mechanism: In heavy nuclei, due to neutron/proton ratio imbalance or structural stacking defects, some α-particle units are in a **metastable state**. **Collective thermal vibrations** within the nucleus (a classical, temperature-related motion) may concentrate energy onto a particular α-particle unit, giving it sufficient kinetic energy. When this kinetic energy exceeds the electrostatic binding energy between that unit and the rest of the nucleus in **a specific direction** (due to asymmetry in the crystal structure or instantaneous fluctuations), that α-particle unit is **classically and directly "knocked out" or "squeezed out"** of the atomic nucleus.

Nature of the process: This is a **classical energy transfer and particle emission process**, analogous to a ball being ejected from a loosely packed spherical structure due to collisions from other balls. The emission kinetic energy of the α-particle is deterministic because it depends on the specific difference between binding energy and Coulomb repulsion energy within the nucleus. The statistical nature of the **half-life** stems from the randomness of thermal vibrations leading to varying waiting times to reach the emission threshold, not from "probabilistic tunneling".

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 February 2026 doi:10.20944/preprints202602.0272.v1

This explanation is fundamentally different from the quantum tunneling picture. It is based on a definitive nuclear structure and classical motion, eliminating reliance on probability wave penetration.

4.3. Why Macroscopic Objects Cannot Tunnel: The Cohesive Aggregate Effect

According to our theory, the impossibility of macroscopic object tunneling is not due to "extremely low probability" but to the **fundamental failure of the physical mechanism**.

Scale and field superposition: A macroscopic object is a dynamic entity cohesive aggregate of ~10^{23} atoms. Its overall charge Existence Field is the vector superposition of a vast number of atomic fields. When interacting with a wall (another cohesive aggregate), the contact area is macroscopic. Any attempted "local weakening" would be instantly overwhelmed and canceled out by the strong field superposition from the surrounding multitude of atoms, **preventing the formation of a stable field channel that penetrates the entire thickness of the object** ($\eta \approx 1$ holds everywhere).

Integrity and coordination: Even if one fantasizes about an atomic-scale channel, the macroscopic object, as a rigid or elastic cohesive aggregate, would require all its atoms to **coordinate simultaneously and move through the channel collectively**, which is mechanically **impossible**. Chemical bonds lock atoms into relative positions, precluding such collective "skeleton-shrinking" motion.

Energy requirement: The kinetic energy of a macroscopic object is proportional to its mass, while the repulsive force between cohesive aggregates is extremely large at close range. Any attempt to make the entire macroscopic object enter a tiny channel in the wall would require energy far exceeding its kinetic energy and would generate unbearable mechanical stress at the contact surface.

Therefore, the absence of macroscopic tunneling is a **necessary, deterministic consequence** under classical physical laws, not a probability issue.

5. Discussion: Essential Differences from Quantum Mechanical Explanation and Theoretical Advantages

5.1. Fundamental Differences in Physical Pictures

The core divergence between quantum mechanics and the classical explanation presented herein lies in their differing presuppositions about the fundamental picture of the physical world. Table 2 systematically compares the key differences between the two paradigms in explaining the tunneling phenomenon:

Table 2. Fundamental Differences Between Quantum Mechanical Explanation and the Classical Explanation in This Paper.

Comparison Dimension	Quantum Mechanical Explanation	Classical Explanation (Based on the Great Tao Model)
Particle State	Probability wave; motion without definite trajectory, constrained by the uncertainty principle.	**Classical entity** with definite mass, charge, position, and trajectory; motion follows Newton's laws.
Barrier Nature	Abstract potential energy function $V(x)$.	**Concrete superposition of Existence Fields**, a quantifiable force field calculable via field strength formulas $E(r)$.
Tunneling Mechanism	Wave function $\psi(x)$ decays exponentially but is non-zero within the barrier region; the particle "appears" on the other side with probability $\|\psi\|^2$. **Process has no specific path, occurs instantaneously**.	**Four-step continuous process**: information coupling → field weakening → channel formation → classical penetration. **Process has a specific path, requires finite time**.

Core Concepts	Probability amplitude, wave function collapse, tunnel effect.	**Existence Field, information coupling, field strength weakening coefficient (η), directional field channel (d).**
Energy Conservation	Possible "energy borrowing" during instantaneous processes (uncertainty principle), but statistically averaged conserved.	**Strict, instantaneous energy conservation** throughout; kinetic energy continuously transforms into work done against resistance within the channel.
Why Macroscopic Objects Cannot	Tunneling probability T decays exponentially with mass and size; macroscopic probability is nearly zero.	**Physical mechanism fails**: field weakening cannot form ($\eta \to 1$), cohesive aggregate cannot collectively coordinate traversal. It is **necessarily impossible**, not a probability issue.
α-Decay Explanation	α-particle wave function penetrates the Coulomb barrier [1,15].	α-particle, as a nuclear crystal structural unit, is classically "squeezed out" by thermal motion within the nucleus [11].

The explanatory paradigm of quantum mechanics is built upon two fundamental postulates: "wave-particle duality" and the "uncertainty principle". Within this framework, particles lose their independent materiality and deterministic motion in the classical sense; their state is described by a wave function pervading space. The tunneling phenomenon is thus interpreted as an inherent property of the wave function—non-zero penetration within the barrier region. This explanation is mathematically efficient and precise, but its cost is sacrificing the **causality** and **intuitiveness** of the physical process for the **probabilistic** and **abstract** nature of the mathematical form [6,7]. It cannot answer the most natural question from a child: "How does the particle actually get through?" More seriously, to maintain this set of microscopic rules, it must accept a profound schism between micro- and macro-physical laws, viewing the determinism of the macro-world as an approximation or emergent phenomenon [9].

In contrast, the explanation in this paper, based on the Great Tao Model, firmly returns to the **materialist** and **deterministic** foundations of classical physics. It first confirms that microscopic particles and macroscopic objects belong to the same category of entities, obeying the same Newtonian mechanics and Maxwellian electromagnetism. The manifestation of the tunneling phenomenon at the microscopic scale is not due to different rules, but because microscopic particles, as isolated or few-particle systems, possess the possibility for their **Existence Field** to engage in fine-grained, local interaction with the barrier field. So-called "tunneling" is actually a classical dynamical process where the particle actively modifies its environment using its own field, "building a bridge" for itself. This picture not only restores the causal chain of the process (information coupling → field weakening → channel formation → penetration) but also naturally explains the reason for macroscopic failure: when the particle number escalates to form a cohesive aggregate, this local, fine-grained field modification is suppressed by the collective, powerful field superposition, and the mechanism ceases to exist. Therefore, the difference between the two explanations is not one of computational accuracy but a fundamental divergence at the level of **worldview** and **physical picture**.

5.2. Theoretical Advantages of the Great Tao Model Explanation

Clarity and intuitiveness of the physical picture: Dispenses with the abstract "probability wave" and "wave-particle duality", restoring microscopic particles to classical entities understandable to the general public. The tunneling process is depicted as a "classical breakout" achieved through "field modification", with each step having a clear physical correspondence.

Traceability and testability of the mechanism: The proposed "field strength weakening coefficient η" and "channel width d" are **in principle measurable physical quantities**. In the future, using ultra-high precision local field probes (such as improved scanning probe techniques), it may be possible to directly or indirectly verify changes in these parameters during tunneling, giving the theory stronger **falsifiability** and **verifiability**.

Logical unification of the micro- and macro-worlds: Successfully explains the tunneling behavior of microscopic particles and fundamentally **derives** the necessity for the impossibility of macroscopic object tunneling within the same classical physics framework. This eliminates the dilemma of the rule schism between micro and macro in quantum mechanics.

Theoretical self-consistency and simplicity: The entire explanatory system is firmly rooted in the first principles of the Great Tao Model and atomic structure theory (fundamental particles, Existence Field, dynamic entities), requiring no additional assumptions. Although its mathematical expressions may be similar in form to quantum mechanics formulas in certain limits, their physical origins are entirely different, and the concepts are more concise.

5.3. Critique of the Traditional Proton-Proton Chain (PP Chain) Tunneling Hypothesis and the Great Tao Model Alternative Picture

In the standard model of stellar (e.g., solar) nuclear fusion, the initial step—the proton-proton chain (PP chain) reaction—is described as two protons overcoming the immense Coulomb repulsion via quantum tunneling to form a deuteron, accompanied by the release of a positron and a neutrino ($p + p \rightarrow {}^2H + e^+ + \nu_e$). Viewed from the perspective of the Great Tao Model, this long-held cornerstone hypothesis has serious flaws in its physical foundation, while the Great Tao Model itself provides a more self-consistent alternative mechanism.

5.3.1. Critique of the PP Chain Hypothesis:

Structural Impossibility: According to the atomic nuclear crystalline structure theory of the Great Tao Model [11], stable atomic nuclei (like the deuteron) require **protons and neutrons to combine via the attraction of opposite-charge Existence Fields (proton positron field and neutron electron field) and spin magnetic forces**. Between two protons (each carrying a positron), there is only strong Coulomb repulsion of like charges, **completely lacking an attractive mechanism for forming a stable bound state**. Forcibly assuming they can combine violates fundamental electromagnetic interaction laws.

Fundamental Absence of Field Weakening Conditions: As described in Section III of this paper, effective tunneling (or any form of close-range combination) requires local weakening of the Existence Field ($\eta < 1$). In the scenario of two protons, the superposition of their positive charge Existence Fields can only **enhance repulsion** ($\eta > 1$), making the formation of a low-resistance "field channel" impossible. Therefore, the physical basis for so-called "tunneling" does not exist.

Dependence on Ad Hoc Particles and Interactions: To compensate for the above deficiencies, the standard model introduces β^+ decay theory ($p \rightarrow n + e^+ + \nu_e$) and the related "weak interaction" [16,17] along with the almost undetectable "neutrino". From the perspective of the Great Tao Model, this constitutes **an ad hoc hypothesis** introduced to salvage an erroneous premise (direct proton-proton combination), increasing the complexity and arbitrariness of the theory.

5.3.2. Alternative Stellar Energy Mechanism of the Great Tao Model:

The Great Tao Model has already explicitly indicated that the primary source of solar neutrinos is not the PP chain and has proposed an alternative picture based on classical particle physics [11]. According to the Great Tao Model, under the high-temperature, high-pressure environment within the Sun:

A dynamic equilibrium system exists: The solar interior matter is in a complex dynamic equilibrium, including the isomer equilibrium of **neutron-antineutron**, the equilibrium between free and bound nucleons, and the equilibrium between proton-electron plasma and neutrons.

True source of neutrinos: Free neutrons or antineutrons are unstable; they can dissociate into more fundamental particles (such as electrons, positrons, protons, antiprotons). Subsequently, these

 doi:10.20944/preprints202602.0272.v1

matter-antimatter particles meet and combine through the **Radiative Combination (RC) Reaction** to form **neutrinos** (in the Great Tao Model, neutrinos are tightly bound states of electrons and positrons) and substons, releasing enormous radiant energy in the process. **This is the core classical mechanism for solar neutrino production and energy release.**

The true pathway of nuclear fusion: Under high temperature and pressure, **protons and neutrons can directly and classically collide and combine to form atomic nuclei** (e.g., deuteron, $p + n \rightarrow {}^2H$), which can further combine with electrons to generate heavier elements. This process is entirely based on the attraction of opposite charges and known classical interactions, without the need to introduce proton-proton tunneling and weak interactions.

Therefore, the Great Tao Model not only raises fundamental objections to the "tunneling" initiation step of the PP chain but also provides a completely self-consistent, alternative picture of stellar internal nuclear processes and energy generation mechanisms based on its own theoretical framework. This demonstrates the potential and internal consistency of the Great Tao Model as a unified theory in addressing complex problems such as astrophysics.

6. Conclusions and Outlook

Based on the **Great Tao Model** and the **Unified Theory of Atomic and Molecular Structure**, this paper has successfully constructed a **classical physical explanation framework** for the quantum tunneling phenomenon. The study reaches the following core conclusions:

(1) **Quantum tunneling is not an inherent "quantum" phenomenon**; it can be fully and self-consistently explained within the paradigm of classical physics. Its essence is a **deterministic process** where microscopic particles temporarily modify the local force field environment through Existence Field interactions, opening a low-resistance channel and traversing it classically.

(2) **"Local weakening of the Existence Field" and "formation of a directional field channel"** are the two core physical mechanisms of this process. They are driven by the **vector superposition principle of the Existence Field** and the **magnetic field effects of moving particles**, and can be quantitatively described by concepts such as the **field strength weakening coefficient** η and the **channel width *d***.

(3) **Macroscopic objects absolutely cannot tunnel**. The fundamental reason is not an extremely low probability, but that the **field superposition characteristics** and **structural integrity of the dynamic entity cohesive aggregate** render the aforementioned microscopic tunneling mechanism **physically unrealizable**. This achieves a logical unification of micro- and macro-physical laws.

(4) Case studies on **scanning tunneling microscopy (STM)** and **α-decay** show that this classical framework can not only be compatible with existing experimental observations (e.g., STM resolution, single-valued α-particle energy) but also provide more intuitive, physically clearer mechanism explanations than quantum mechanics, particularly by reducing α-decay to a classical particle emission process from a nuclear crystal structure.

This theory raises fundamental objections to some forced assumptions in traditional theories (such as the proton tunneling initiation of the stellar PP chain) and provides an alternative classical picture of stellar nuclear processes based on the Great Tao Model's own framework, demonstrating its inherent potential and broad application prospects as a new paradigm for fundamental research.

Outlook:

This research opens a new direction. Future work could attempt direct or indirect observations of **local field strength changes during tunneling** (verifying η) and the **equivalent channel scale** by developing ultra-high spatial and temporal resolution experimental techniques, providing conclusive experimental evidence for the theory. Furthermore, this framework could be

 doi:10.20944/preprints202602.0272.v1

systematically applied to more "quantum" phenomena, such as the Josephson effect and quantum dot transport, to test its universality and further develop corresponding quantitative calculation tools. The Great Tao Model and its derived classical explanation framework hold the potential to provide a new perspective for understanding the microscopic world that is more in line with physical intuition and more unified.

References

1. Gamow, G. Zur Quantentheorie des Atomkernes. *Zeitschrift für Physik* **51**, 204–212 (1928).
2. Fowler, R. H. & Nordheim, L. Electron emission in intense electric fields. *Proceedings of the Royal Society of London. Series A* **119**, 173–181 (1928).
3. Binnig, G. & Rohrer, H. Scanning tunneling microscopy. *Helvetica Physica Acta* **55**, 726–735 (1982).
4. Griffiths, D. J. *Introduction to Quantum Mechanics* (2nd ed.). (Pearson Prentice Hall, 2005).
5. Merzbacher, E. The early history of quantum tunneling. *Physics Today* **55**(8), 44–49 (2002).
6. Bohm, D. A suggested interpretation of the quantum theory in terms of "hidden" variables. I & II. *Physical Review* **85**, 166–193 (1952).
7. Bell, J. S. On the problem of hidden variables in quantum mechanics. *Reviews of Modern Physics* **38**, 447–452 (1966).
8. Leggett, A. J. Testing the limits of quantum mechanics: motivation, state of play, prospects. *Journal of Physics: Condensed Matter* **14**(15), R415–R451 (2002).
9. Zurek, W. H. Decoherence, einselection, and the quantum origins of the classical. *Reviews of Modern Physics* **75**, 715–775 (2003).
10. Elze, H.-T. The attractor and the quantum states. *International Journal of Theoretical Physics* **48**, 3075–3086 (2009).
11. Zeng, J. & Zeng, T. The Great Tao Model — The Yin-Yang Model of Elementary Particles and the Theory of Existence Field. *Preprints* **2025011006** (2025).
12. Zeng, J. & Zeng, T. A Unified Theory of Atomic and Molecular Structure. *Preprints* **2025011033** (2025).
13. Michaelson, H. B. The work function of the elements and its periodicity. *Journal of Applied Physics* **48**(11), 4729–4733 (1977).
14. Chen, C. J. *Introduction to Scanning Tunneling Microscopy* (2nd ed.). (Oxford University Press, 2008).
15. Gurney, R. W. & Condon, E. U. Quantum mechanics and radioactive disintegration. *Nature* **122**, 439 (1928).
16. Bahcall, J. N. *Neutrino Astrophysics*. (Cambridge University Press, 1989).
17. Adelberger, E. G. et al. Solar fusion cross sections. *Reviews of Modern Physics* **83**(1), 195–245 (2011).
18. Simmons, J. G. Generalized formula for the electric tunnel effect between similar electrodes separated by a thin insulating film. *Journal of Applied Physics* **34**(6), 1793–1803 (1963).
19. Tersoff, J. & Hamann, D. R. Theory of the scanning tunneling microscope. *Physical Review B* **31**(2), 805–813 (1985).
20. Wolynes, P. G. Quantum theory of chemical reaction dynamics. *Annual Review of Physical Chemistry* **31**, 345–381 (1980).