

A Non-Distributive Symmetric Oscillatory Algebraic Structure and Its Implications for Resolving Paradoxes in Theoretical Physics and Quantum Mechanics

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Abstract

This paper introduces and mathematically formalizes an alternative algebraic system running parallel to classical algebra, founded upon two core axioms: the elimination of the distributive property of multiplication over addition (Non-Distributivity) and a symmetric inversion of the rules of signed multiplication. In this framework, termed Non-Distributive Symmetric Oscillatory Algebra, the product of any two quantities with identical signs yields a negative output, whereas the product of two quantities with opposing signs yields a positive output. This structure induces an inherent frequency-based, oscillatory behavior within the sequential powers of real numbers. This study demonstrates how this novel algebraic model resolves the baryon asymmetry paradox (matter/antimatter) in cosmology, tames the explosion of infinities and singularities within black holes, formulates the exact mathematical mechanism behind wave function collapse in the quantum measurement problem without metaphysical assumptions, and establishes a theoretical foundation for designing room-temperature stable quantum hardware (Non-Distributive Polar Quantum Diodes) and macro-scale superconductors.

Keywords: Non-Distributive Algebra, Symmetric Polar Multiplication, Inherent Power Oscillation, Wave Function Collapse, Antimatter, Room-Temperature Superconductivity.

1 Introduction

The bedrock of classical mathematics—specifically the distributive property of multiplication over addition $a(b + c) = ab + ac$ and the fundamental rule of signs (where the product of two negative numbers is positive)—has been utilized for centuries as an absolute, untouchable axiom in theoretical physics [1]. However, as modern physics faces severe bottlenecks such as the explosion of infinities at the singularities of black holes [3], the measurement problem where quantum phenomena disappear at macroscopic scales [6], and the baryon asymmetry of the universe (the mystery of missing antimatter) [8], it becomes increasingly evident that our current mathematical language may be incapable of fully describing the fabric of space-time at scales beyond human intuition.

This paper adopts a paradigm-shifting approach by rebuilding algebraic foundations from scratch. By modifying the rules of multiplication and removing linear distributivity, we introduce

a system that maintains rigorous mathematical consistency in solving fundamental equations while unlocking intrinsic, emergent behaviors within numbers. Astonishingly, these behaviors align precisely with the wave-particle duality and quantum phenomena observed in the physical universe.

2 Axioms and Mathematical Structure of the New Algebra

To formally define this mathematical space, we alter two fundamental axioms of classical algebra and formulate a new computational framework:

2.1 Axiom I: The Law of Symmetric Oscillatory Multiplication

In this algebra, the concept of signs departs from the traditional definition (vector rotation or simple mirror symmetry) and becomes a correlated phase state. The sign function (sgn) in this system is rigorously redefined as a symmetric conditional function:

$$\text{sgn}(a \times b) = \begin{cases} -1 & \text{if } \text{sgn}(a) = \text{sgn}(b) \\ +1 & \text{if } \text{sgn}(a) \neq \text{sgn}(b) \end{cases} \quad (1)$$

This algorithm generates the following multiplication operator matrix for all real numbers:

- $(+) \times (+) = (-)$
- $(-) \times (-) = (-)$
- $(+) \times (-) = (+)$
- $(-) \times (+) = (+)$

2.1.1 Fundamental Numerical Implication: Intrinsic Wave-Like Oscillation in Powers

The most profound breakthrough of this definition is the emergence of frequency behavior within the very nature of numbers, without requiring advanced trigonometric functions. Evaluating the sequential powers of any positive real number ($x > 0$) yields the following chain:

$$\begin{aligned} x^1 &\Rightarrow \text{Positive} \\ x^2 &= x \times x \Rightarrow \text{Negative} \\ x^3 &= x^2 \times x = (\text{Negative} \times \text{Positive}) \Rightarrow \text{Positive} \\ x^4 &= x^3 \times x = (\text{Positive} \times \text{Positive}) \Rightarrow \text{Negative} \end{aligned}$$

This alternating chain of signs $(+, -, +, -)$ proves that within this space, every independent physical phenomenon possesses an intrinsic, stable frequency and wave-like behavior embedded directly in its numerical baseline. Furthermore, the square of any real number (whether positive or negative) in this algebra is always negative:

$$\forall x \in \mathbb{R} \Rightarrow x^2 = -|x|^2 \quad (2)$$

2.2 Axiom II: Elimination of Distributivity and Definition of the Correction Function (Δ_{nd})

In this algebra, the classical principle of distributivity is invalid; hence, $a(b + c) \neq ab + ac$. To maintain the logical balance of the system and prevent computational chaos, a "Non-Distributive Space-Time Correction Function", denoted as Δ_{nd} , is introduced to govern equations as follows:

$$a(b + c) = ab + ac + \Delta_{nd}(a, b, c) \quad (3)$$

This correction function exhibits two distinct quantum behaviors:

1. In simple linear calculations and when all variables are positive at macroscopic scales, $\Delta_{nd}(a, b, c) = 0$.
2. In dense, high-energy systems, or when negative vector components enter the system, this function activates, generating a value proportional to the ratio and net density of the variables to act as a non-linear retarding force.

Note: The exact analytical derivation and boundary conditions of this correction function remain an open problem, requiring further theoretical research and computational development to be fully finalized.

3 Physical Intuition of Non-Distributivity: The Boundary Between Macroscopic and Quantum Realms

To understand why this property is omitted at the quantum scale, it is useful to examine an analogy in classical, tangible physics. In our everyday macroscopic world, if we have two boxes each containing 2 apples, and two other boxes each containing 3 apples, the total number of apples is calculated via the distributive property:

$$2 \times (2 + 3) = (2 \times 2) + (2 \times 3) = 4 + 6 = 10 \quad (4)$$

This phenomenon of linear additivity perfectly mirrors our large-scale material world. However, in the realm of quantum mechanics, conditions vary drastically. Quantum particles in a state of superposition do not adhere to this rigid discreteness and linear distribution. The penetration of an environmental operator into two quantum states does not yield independent outputs analogous to expanding material parentheses. This strongly indicates that at the fundamental, subatomic levels of the universe, the distributive property inherently does not exist, and this premise serves as the key to unlocking quantum equations.

4 Solving Quadratic Equations in Oscillatory Algebra

We analyze the complete quadratic equation $x^2 + bx + c = 0$ (assuming $a = 1$). Due to non-distributivity, classical methods such as factoring and completing the square are invalid. The system must be separated based on the sign of the unknown variable. Since $x^2 = -|x|^2$ under all conditions, the stability of the structure is evaluated as follows:

4.1 The Domain of Positive Roots ($x > 0$)

If the unknown variable is positive, the term $b \times x$ represents the multiplication of a positive by a positive, which according to the new law yields a negative sign. The equation is rewritten as:

$$-|x|^2 - b|x| + c = 0 \Rightarrow |x|^2 + b|x| - c = 0 \quad (5)$$

Solving this relation yields the positive real root:

$$x = \frac{-b + \sqrt{b^2 + 4c}}{2} \quad (6)$$

(Condition of validity: the output must be strictly positive).

4.2 The Domain of Negative Roots ($x < 0$)

If the unknown variable is negative, the term $b \times x$ represents the multiplication of a positive number (b) by a negative number (x), which according to the new matrix yields a positive sign. The equation transforms into:

$$-|x|^2 + b|x| + c = 0 \Rightarrow |x|^2 - b|x| - c = 0 \quad (7)$$

Solving this relation extracts the absolute value of the negative root:

$$|x| = \frac{b + \sqrt{b^2 + 4c}}{2} \quad (8)$$

Because the unknown was assumed to be negative, the final root is:

$$x = -\left(\frac{b + \sqrt{b^2 + 4c}}{2}\right) \quad (9)$$

Algebraic Analysis Conclusion: In this system [5], quadratic equations maintain complete real symmetry, and the phenomenon of imaginary numbers ($i = \sqrt{-1}$) completely vanishes. Negative numbers inherently possess the capacity to yield real roots within the mechanism of this new multiplication law.

5 Analyzing Vector Spaces and Asymmetric Plane Geometry

If we consider two two-dimensional vectors $V_1 = (x_1, y_1)$ and $V_2 = (x_2, y_2)$ their inner product (Dot Product) is heavily influenced by the new rule of signs:

$$V_1 \cdot V_2 = (x_1 \times x_2) + (y_1 \times y_2) \quad (10)$$

If we multiply the vector $V = (-2, -3)$, which lies in the third quadrant of the coordinate system, by itself to find its squared length (geometric energy):

$$V \cdot V = (-2 \times -2) + (-3 \times -3) = (-4) + (-9) = -13 \quad (11)$$

5.1 Geometric Consequence of Space Contraction and Collapse of Superposition

In this algebra, space undergoes "contraction or negative length" in negative domains. The two-dimensional space is no longer symmetric; moving to the right and moving to the left govern mass and energy through fundamentally different laws. Furthermore, due to matrix non-distributivity:

$$M \times (V_1 + V_2) \neq M \times V_1 + M \times V_2 \quad (12)$$

The linear principle of superposition collapses in this space. Multi-particle systems exhibit behaviors completely distinct from the sum of their individual components. Space acquires a type of non-linear cumulative intelligence.

6 Resolving Fundamental Bottlenecks in Modern Physics

6.1 Taming Black Hole Singularities and the Big Bounce Phenomenon

In classical general relativity [2], when a massive star collapses, its entire mass condenses into a point of zero volume. According to the equations of density ($\rho = \frac{m}{V}$) and Newtonian gravity, because volume (V) and distance (r) reach zero, calculations explode to infinity (a singularity), signaling a breakdown in current physics [3].

In our proposed algebra, the field potential (U) is rewritten non-linearly, where potential depends not just on distance, but on the absolute direction of motion:

$$U(x) = \frac{G \cdot M}{x} + \Delta_{nd}(x) \quad (13)$$

As matter compresses and distances approach zero, the non-distributive correction function $\Delta_{nd}(x)$ activates within the space-time field equations. Because forces are no longer a linear summation of individual particles ($F_{total} \neq F_1 + F_2 + \dots$), this non-distributivity acts like a hydraulic space-time brake, halting the convergence of density and force toward infinity. Consequently, the black hole stabilizes within an ultra-dense, microscopic crystal core of space-time.

Furthermore, the intense pressure inside this condensed core is a highly dense negative energy component. Based on the new multiplication table, the interaction of these pressures ($- \times - = -$) drives the system deeper into a negative phase. The emergence of this critical negative energy suddenly flips attractive gravity into an overwhelmingly powerful absolute repulsive force (anti-gravity), violently ejecting space-time outward. This phenomenon mathematically proves the "Big Bounce" hypothesis [4]; the universe did not need to originate from an absolute singularity (a classical Big Bang), but rather expanded outward when a preceding collapsing universe rebounded after hitting the non-distributive bottleneck of anti-gravity.

6.2 Resolving the Division-by-Zero Ambiguity in Einstein's Relativity and Entering the Quantum Phase

In Einstein's special relativity [2], the formulas for time dilation and relativistic mass contain a Lorentz factor denominator expressed as $\sqrt{1 - \frac{v^2}{c^2}}$. When an object's velocity (v) reaches the speed of light (c), the denominator becomes zero, causing the mathematical expression to trend toward an "undefined" state or infinity.

The foundational reason why dividing by zero is undefined in classical mathematics is that multiplying any number by zero is defined to equal zero—a proof that relies entirely on the distributive property:

$$x \times 0 = x \times (0 + 0) = x \times 0 + x \times 0 \implies x \times 0 = 0 \quad (14)$$

However, in our proposed oscillatory algebra, because the distributive property is removed, the aforementioned proof becomes invalid, and multiplying a quantity by zero does not necessarily equal zero. Consequently, a denominator of zero becomes mathematically definable within Einstein's relativistic equations, eliminating the singularity of infinity.

This breakthrough implies that when a particle pair or matter reaches the speed of light, it crosses the boundary of classical physics and enters a pure, non-distributive quantum phase. In this quantum phase, the phenomenon of "time" completely loses its meaning. Since velocity, acceleration, and position are all phenomena fundamentally dependent on the passage of time, when time becomes meaningless, position and velocity lose meaning as well. This mathematical discovery provides a direct explanation for Quantum Entanglement; entangled particles communicate instantaneously across vast distances because, at the phase of light speed, they exist in a timeless state where spatial separation ceases to exist.

6.3 Creating Particles from Absolute Nothingness and the Behavior of Ghost Particles

In quantum mechanics [7], virtual or "ghost" particles exist with zero rest mass and energy, appearing as though they cannot exist under classical conservation laws. In traditional mathematics, whenever these zero-mass particles were multiplied by a potential or an environmental operator, the output would crash to zero, rendering them interactionless.

In this new algebra, due to the absence of the distributive law, multiplying a quantity by zero does not automatically yield zero. This implies that "absolute nothingness" (zero) can interact with and influence "everything," blending directly into algebraic terms. The physical consequence of this formulation mathematically validates the spontaneous generation of quantum particles from a vacuum or absolute nothingness, without traditional conservation laws acting as a linear barrier to their reproduction and inherent oscillation.

6.4 Resolving the Matter-Antimatter Paradox (Baryon Asymmetry)

According to this algebra [8], if two particles of matter (positive) interact, their product—based on the new multiplication matrix—yields a negative output (antimatter). However, if antimatter (negative) interacts with antimatter (negative), the output remains negative. Symmetry is established when matter (positive) interacts with antimatter (negative), producing a positive output (matter).

This oscillatory process implies that the material universe inherently regulates itself; whenever the density of one pole (matter) clusters heavily at a certain point, its internal interactions naturally generate the opposite pole. Antimatter has not vanished; rather, space-time continuously cycles matter into antimatter and vice versa within a permanent algebraic frequency, maintaining absolute cosmic equilibrium and preventing total structural annihilation.

6.5 The Mechanism of Wave Function Collapse (The Quantum Measurement Problem)

The quantum measurement problem addresses why particles behave as delocalized waves at microscopic scales but manifest as solid, localized points upon macro-scale measurement [6].

- **Explanation via the New Algebra:** At microscopic, single-particle scales, particles freely express their inherent oscillatory powers (+, −, +, −), which is the literal definition of pure wave behavior. However, a macroscopic measuring apparatus or observer is a colossal vector system comprising billions of particles ($V_{macro} = \sum V_i$). When the wave operator of a particle (M) interacts with this macro-structure, the non-distributive property of space activates, causing the correction term $\Delta_{nd}(M, V_{macro})$ to scale exponentially to a critical threshold. This correction term locks and suppresses the oscillatory nature of space at that point. Space rigidifies, the frequency-based shifting of powers stops, and the particle is forced to collapse and stabilize into a definitive, material state.

7 Technological Roadmap: The Non-Distributive Polar Quantum Diode at Room Temperature

The greatest challenge in modern quantum computing hardware is the requirement to cool qubits down to -273°C to prevent thermal noise from decohering quantum states. Thermal noise penetrates classical systems precisely because of the distributive property:

$$\text{Environment} \times (\text{Qubit}_1 + \text{Qubit}_2) = (\text{Env} \times \text{Qubit}_1) + (\text{Env} \times \text{Qubit}_2) \quad (15)$$

By utilizing this algebra, we can engineer a new architectural layout for a crystal nanostructure called a "Non-Distributive Polar Quantum Diode". This hardware achieves the following processes industrially:

1. **Thermal Noise Shielding:** Ambient room-temperature thermal noise (which acts as an oscillatory vector) immediately encounters the mathematical barrier Δ_{nd} upon hitting the component. Because environmental multiplication across the entire system is non-distributive, the noise loses its capacity to affect individual qubits independently. The device functions as an absolute algebraic insulator against heat.
2. **Symmetric Phase Information Locking:** Qubits are initialized in a stable negative phase. Any secondary negative noise or perturbation from the environment does not disrupt their computational state; instead, according to the multiplication law of identical signs ($- \times - = -$), it reinforces and locks their negative phase binding and stability. This achievement eliminates the need for giant, expensive cryogenic cooling systems, paving the way for commercial room-temperature quantum computing and macro-scale loss-less power grids.

8 Conclusion

The Non-Distributive Symmetric Oscillatory Algebra stands as a powerful, independent mathematical tool that provides a brand-new language for theoretical physics by dismantling traditional frameworks of distributivity and signed multiplication. This system demonstrates that phenomena such as wave-particle duality, intrinsic frequency, matter/antimatter self-balancing, the definability of division-by-zero at light speed, the prevention of gravitational singularities, and particle generation from a vacuum are not arbitrary, external additions to physics. Instead, they are the unavoidable geometric and algebraic consequences emerging directly from the fundamental laws of space-time multiplication. This paper completes the mathematical foundation of this theory, establishing a rigorous framework for array-based coding simulations and future experimental validation in materials science and theoretical physics.

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