



(REVIEW ARTICLE)



Decoding the Universal Language: A Mathematical Synthesis of Science, Cosmic Evolution, and Divine Wisdom

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Abstract

This comprehensive work elaborates on the "Natural and Universal Mathematics" paradigm, redefining mathematics not merely as a tool for calculation but as the common denominator of all scientific disciplines, the heart of science, and a universal language of communication that makes sense of the building blocks of the universe. The study examines mathematical reality across a broad spectrum, starting from the ontological reconceptualization of the concept of zero, through the foundations of set theory, mathematical formulations of quantum mechanics, information theory and entropy, mathematical cosmology, the qualitative transformation of numbers, the distinction between infinity and eternity, and the hierarchy of science and *Ilm* (Divine Knowledge). The core argument is that mathematics discovers rather than invents reality, and that the universal language consists of mathematical structures.

Keywords: Natural and Universal Mathematics; Mathematical Universe Hypothesis; Ontology of Zero; Cosmic Evolution; Science and Ilm; Information Entropy; Universal Language

1. Introduction: The Identity of Mathematics and Nature

Although mathematics is traditionally viewed as an abstract discipline, it is, in fact, the operational language of nature itself. The "Natural and Universal Mathematics" paradigm redefines mathematics not merely as a tool for calculation but as the common denominator of all scientific disciplines, the heart of science, and a universal language of communication that makes sense of the building blocks of the universe (Alkan & Demirkuş, 2014; Demirkuş & Alkan, 2018).

1.1. The Mathematical Universe Hypothesis: A Radical Proposition

Max Tegmark's Mathematical Universe Hypothesis (MUH) represents one of the most radical propositions in contemporary cosmology and philosophy. The hypothesis makes a striking claim: the physical universe is not merely describable by mathematics—it *is* mathematics—specifically, an abstract mathematical structure (Tegmark, 2014).

The MUH is based on several key arguments:

- Our physical world is fully describable by mathematics.
- There are no ineffable qualities that resist mathematical description.
- If a complete description exists and is entirely mathematical, then the thing described must itself be entirely mathematical.

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Observers, like humans, are "self-aware substructures" (SAS) within these mathematical structures. The theory represents mathematicism—the view that only mathematical objects exist—and ontic structural realism (Gabriel, 2015).

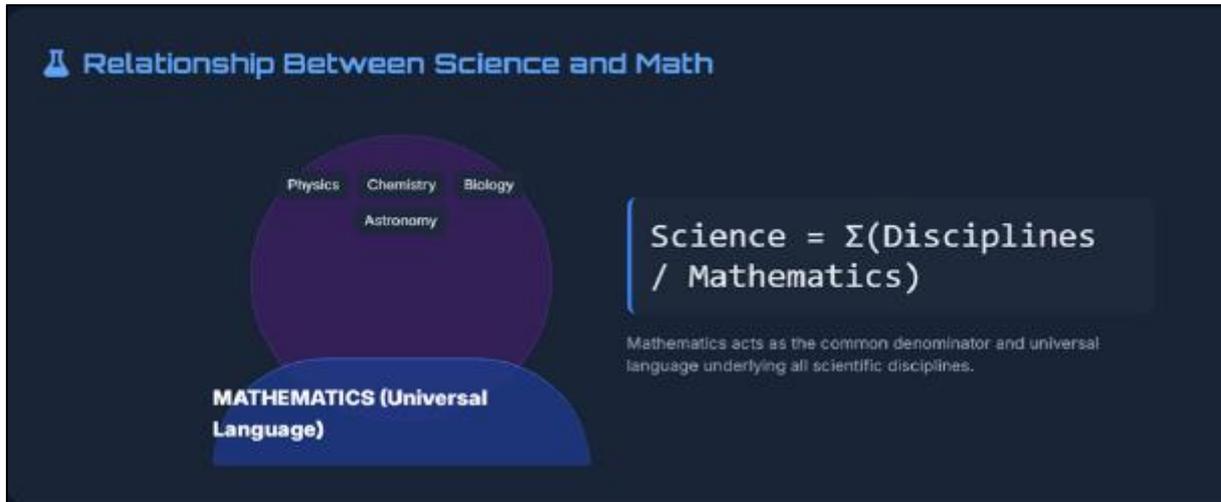


Figure 1 Science Formula Diagram

1.2. The Mathematical Formulation of Science

Within Natural Mathematics, the relationship between mathematics and the sciences can be expressed by a fundamental formula: **Science = $\Sigma(\text{Scientific Disciplines} / \text{Mathematics})$** . This equation encodes deep insights about the structure of knowledge (Demirkuş, 2016; Shapiro, 2000). Figure 1

Mathematics appears in the denominator, signifying that it serves as the common foundational substrate underlying all scientific disciplines. Each science—physics, chemistry, biology, astronomy—manifests mathematical principles applied to specific phenomena.

The metaphor of mathematics as the "heart" of science is apt (Demirkuş & Alkan, 2024; Colyvan, 2012). Just as the heart pumps blood to all organs, mathematics provides the necessary logical structure and quantitative tools for every scientific discipline. Mathematics possesses remarkable autonomy—it can progress from axioms to theorems through pure reason without empirical input (Demirkuş, 2023; Bostock, 2009).

2. Ontological Reconceptualization of Zero: From Nothingness to Spatial Boundaries

The most fundamental revolution in Natural and Universal Mathematics is the redefinition of the concept of zero. Zero has a fascinating and complex history spanning multiple civilizations and philosophical traditions (Kaplan, 1999; Seife, 2000).

2.1. Historical Development: From Babylon to India

The concept of zero emerged independently in several ancient civilizations:

- Babylonians (3rd century BC): Placeholder for empty positions in their sexagesimal system.
- Mayans (4th century AD): Sophisticated zero symbol in their vigesimal calendar system.
- Indians (1st millennium AD): Full mathematical treatment influenced by the concept of *Śūnyatā* (emptiness).

Brahmagupta (AD 628), in his work *Brahmasphutasiddhanta*, formalized arithmetic operations involving zero and established the rules:

- $a + 0 = a$
- $a - 0 = a$

- $a \times 0 = 0$
- $0 \div a = 0$

2.2. The Islamic World and Transmission to Europe

The transmission of zero from India to Europe was accelerated during the Islamic Golden Age (9th century) by the Persian scholar Muḥammad ibn Mūsā al-Khwārizmī. Al-Khwārizmī developed an Arabic numeral system including zero, called *sifr* in Arabic (Ifrah, 2000).

2.3. Contemporary Philosophical Investigations

Modern philosophy has returned to zero with renewed interest, recognizing that it presents unique epistemological and metaphysical puzzles (Rotman, 1987; Varzi, 2006).

Brian Rotman's *Signifying Nothing: The Semiotics of Zero* (1987) examines zero as a sign that emerged in specific historical contexts. Rotman links the emergence of zero to other innovations representing absence: the vanishing point in Renaissance perspective, imaginary money, and reflexive self-reference in language and logic.

Any realist account of zero must address several constraints (Varzi, 2006):

- **Ontological Constraint:** Zero must be ontologically similar to other numbers.
- **Phenomenological Constraint:** Must explain why zero is presented as nothingness.
- **Technical Role Constraint:** Must explain how zero fulfills similar roles in different contexts.
- **Epistemological Constraint:** Must provide a satisfactory story about how we acquire knowledge about zero.

2.4. Eight Varieties of Zero in Natural Mathematics

Natural Mathematics proposes eight different types of zero, each corresponding to different aspects of reality (Demirkus & Alkan, 2017; Demirkus, 2025): Figure 2

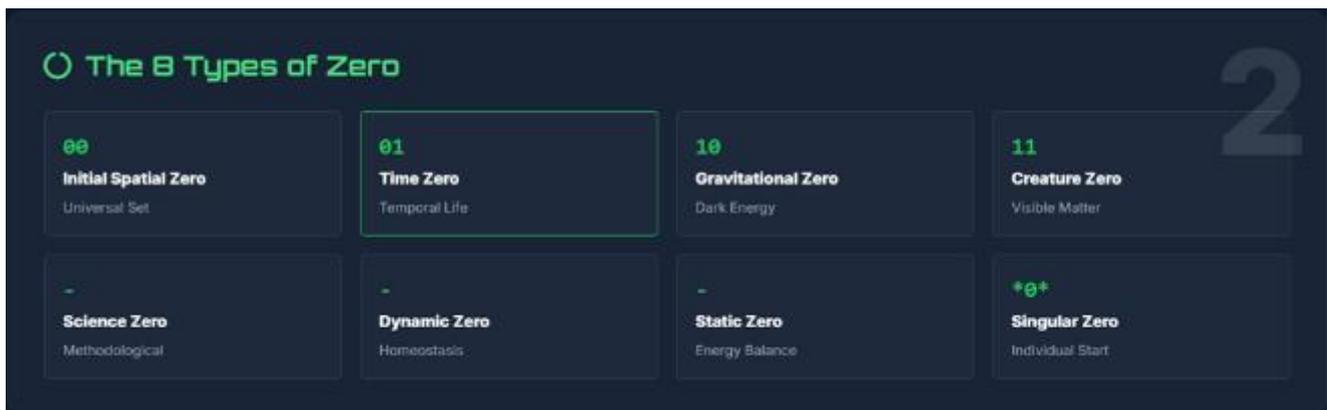


Figure 2 Table of Eight Types of Zero

- **Primary Spatial Zero (00):** Serves as the ultimate container—the universal set from creation to apocalypse.
- **Temporal Zero (01):** Represents transient life approaching zero at eternal speed, related to Einstein's time dilation.
- **Gravitational Zero (10):** Corresponds to dark energy (68-73% of the universe) driving expansion.
- **Creature Zero (11):** Represents life-bearing energy—4-5% visible matter.
- **Scientific Zero:** Provides methodological foundation.
- **Dynamic Zero:** Signifies homeostatic balance.
- **Static Zero:** Represents dark energy-dark matter equilibrium.
- **Singular Zero (*0*):** The individual starting point of every being.

This typology reveals that "zero" encompasses different concepts playing distinct roles.

3. Foundations of Set Theory: From Cantor to Zermelo-Fraenkel

The foundation of modern set theory is Zermelo-Fraenkel set theory (ZF, or ZFC with the Axiom of Choice), formulated by Ernst Zermelo (1908) and Abraham Fraenkel (1922) to avoid paradoxes like Russell's paradox (Russell, 1903). Figure 3



Figure 3 Russell's Paradox Flowchart

3.1. Russell's Paradox: A Foundational Flaw

Bertrand Russell's paradox (1903) exposed a fundamental flaw in naïve set theory, triggering a crisis in the foundations of mathematics (Russell, 1903).

The Paradox: Consider the set R of all sets that do not contain themselves as members. Does R contain itself?

If R contains itself, then by definition it should not contain itself.

If R does not contain itself, then by definition it must contain itself. In both cases, we reach an impossibility.

3.2. Zermelo-Fraenkel Axiomatization

Zermelo-Fraenkel set theory (ZF, or ZFC with the Axiom of Choice) provides a rigorous axiomatic framework that preserves the foundational properties necessary for mathematics while preventing contradictions like Russell's paradox (Zermelo, 1908; Fraenkel, 1922; Jech, 2003; Kunen, 2011).

The system's nine fundamental axioms:

- **Axiom of Extensionality:** Two sets are identical if and only if they have exactly the same elements.
- **Axiom of the Empty Set:** There exists a set with no elements.
- **Axiom of Pairing:** For any two sets a and b , there exists a set $\{a, b\}$ that contains exactly a and b as members.
- **Axiom of Union:** For any collection F of sets, there exists a set containing all elements that belong to at least one set in F .
- **Axiom of the Power Set:** For any set S , there exists a set $P(S)$ consisting of all subsets of S .
- **Axiom of Infinity:** There exists an infinite set.
- **Axiom Schema of Replacement:** If F is a definable function and A is a set, then the image of A under F is also a set.
- **Axiom of Regularity (Foundation):** Every non-empty set contains an element disjoint from itself.
- **Axiom of Choice (AC):** For any collection of non-empty sets, there exists a function that selects exactly one element from each set.

3.3. Gödel's Incompleteness Theorems

Kurt Gödel's incompleteness theorems (1931) constitute one of the deepest and most surprising results in mathematical logic, fundamentally altering our understanding of what formal systems can and cannot achieve (Gödel, 1931).

- **First Incompleteness Theorem:** States that in any consistent formal system F powerful enough to express basic arithmetic, there exist true statements about natural numbers that can neither be proved nor disproved within F .

- **Second Incompleteness Theorem:** States that no sufficiently powerful consistent formal system can prove its own consistency.

The philosophical implications are profound. Mathematical truth transcends any particular formal system. There will always be truths that remain beyond the reach of our formal axiomatic systems yet remain mathematically valid.

4. Quantum Mechanics and Mathematical Foundations

The development of quantum mechanics in the 1920s represents one of the most significant applications of advanced mathematics to physical reality. Three major formulations emerged almost simultaneously, each highlighting different aspects of quantum phenomena.

4.1. Heisenberg's Matrix Mechanics

Werner Heisenberg developed matrix mechanics in 1925 while working under Max Born in Göttingen (Heisenberg, 1925). His approach was operational and abstract, focusing on observable quantities without revealing the underlying structure. Figure 4

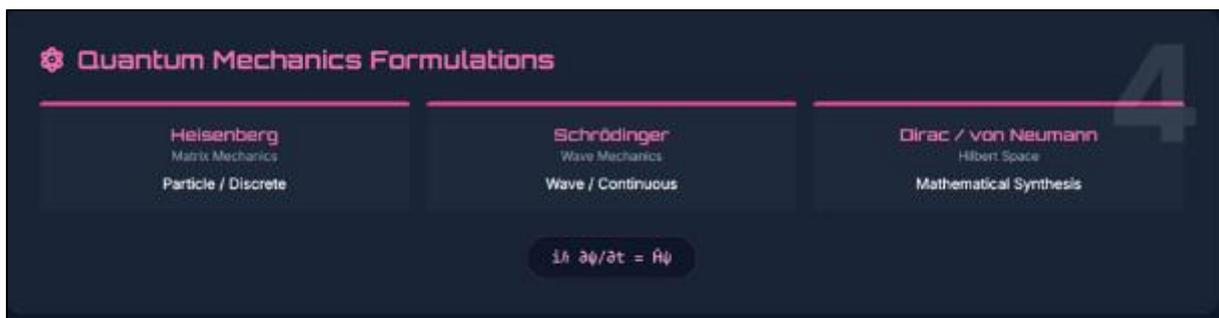


Figure 4 Comparison of Quantum Formulations

When Born examined Heisenberg's results, he recognized that the mathematics represented infinite-dimensional matrices. Together with Pascual Jordan, they developed a complete theory of atoms and transitions (Born & Jordan, 1925).

4.2. Schrödinger's Wave Mechanics

Erwin Schrödinger developed wave mechanics in 1926 as an alternative formulation emphasizing wave functions and differential equations (Schrödinger, 1926).

The Schrödinger equation: $i\hbar \partial\psi/\partial t = \hat{H}\psi$, describes how the quantum state of a physical system changes over time.

4.3. The Synthesis by Dirac and von Neumann

Paul Dirac (1930) showed that both Heisenberg's and Schrödinger's approaches were different representations of the same fundamental theory via transformation theory (Dirac, 1930). He introduced the bra-ket notation, still used today.

John von Neumann's *Mathematical Foundations of Quantum Mechanics* (1932) provided the rigorous mathematical synthesis that reconciled the formulations through the framework of Hilbert spaces (von Neumann, 1932).

4.4. The Copenhagen Interpretation

Max Born's probabilistic interpretation (1926) was central to the Copenhagen interpretation championed by Niels Bohr. The square of the absolute value of the wave function represents the probability density of finding a particle at a position (Born, 1926).

Einstein famously disagreed with this probabilistic interpretation, believing that "God does not play dice." His exchanges with Bohr, known as the Bohr-Einstein debates, are among the deepest discussions in the philosophy of physics.

5. Information Theory and Entropy

Claude Shannon's groundbreaking 1948 paper, "A Mathematical Theory of Communication," introduced the concept of information entropy, providing a mathematical framework for quantifying information and uncertainty (Shannon, 1948).

5.1. Shannon Entropy

Shannon defined the entropy H of a discrete random variable X with possible values $\{x_1, x_2, \dots, x_n\}$ as:

$$H(X) = -\sum P(x_i) \log_2 P(x_i)$$

This formula quantifies the average amount of information (measured in bits) required to describe the outcome of X .

Key properties:

- Entropy is maximized when all outcomes are equally probable.
- Entropy is zero when one outcome has probability 1.
- For independent variables, the total entropy is the sum of the individual entropies. Figure 5



Figure 5 The Entropy Bridge

5.2. Thermodynamic Connection

The connection between thermodynamic entropy and information entropy reveals profound relationships between physics and information theory.

Ludwig Boltzmann's equation $S = k_B \ln W$ relates thermodynamic entropy S to the number of microstates W , where k_B is the Boltzmann constant.

When probabilities are inserted into the Gibbs entropy formula, it becomes formally identical to Shannon entropy (multiplied by k_B).

5.3. Maximum Entropy Principle

E.T. Jaynes (1957) developed the Maximum Entropy Principle (MaxEnt), providing a systematic method for constructing probability distributions maximally uncommitted beyond incomplete information (Jaynes, 1982).

MaxEnt became foundational to complexity science, providing a rigorous framework for dealing with uncertainty and insufficient knowledge.

5.4. Kolmogorov Complexity

Andrey Kolmogorov (1965), Ray Solomonoff (1960), and Gregory Chaitin (1969) independently introduced Kolmogorov complexity, measuring the descriptive complexity of objects by the length of the shortest computer program that produces the object and halts (Kolmogorov, 1965; Chaitin, 1969).

6. Mathematical Cosmology

Albert Einstein's application of general relativity to cosmology in 1917 marked the birth of modern mathematical cosmology (Einstein, 1917).

6.1. Expanding Universe Models

Alexander Friedmann (1922) and Georges Lemaître (1927) independently discovered expanding universe solutions to Einstein's field equations, laying the groundwork for the Big Bang model (Friedmann, 1922; Lemaître, 1927).

Edwin Hubble's 1929 observations confirmed that distant galaxies are receding and that the recession velocity is proportional to distance—the famous Hubble's Law (Hubble, 1929). Hubble constant: $v = H_0 d$ Figure 6

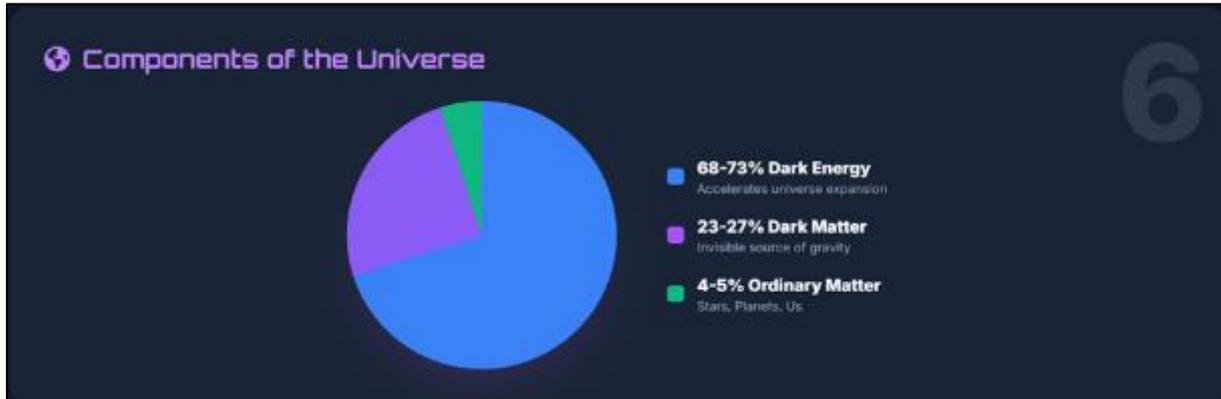


Figure 6 Composition of the Universe

6.2. Dark Energy and the Composition of the Universe

Contemporary cosmology reveals surprising facts about the composition of the universe:

Observations of distant Type Ia supernovae by two independent teams (Perlmutter et al., 1999; Riess et al., 1998) showed that the expansion of the universe is accelerating, leading to the 2011 Nobel Prize in Physics.

Composition of the universe:

- Dark energy: 68-73%
- Dark matter: 23-27%
- Ordinary matter: 4-5%

6.3. Contributions by Penrose and Carroll

Roger Penrose's Weyl Curvature Hypothesis addresses fundamental questions about the initial conditions of the universe (Penrose, 2004). This hypothesis proposes that the universe began in an exceptionally low gravitational entropy state.

Sean Carroll's research explores the deep connection between entropy, the arrow of time, and the initial state of the universe (Carroll, 2019).

7. The Qualitative Transformation of Numbers

Natural Mathematics views numbers not only as symbols denoting quantity but also as qualitative reflections of processes and entities in nature.

7.1. Proposed New Number Categories

Natural Mathematics proposes several new number categories that better reflect physical and conceptual reality (Demirkus, 2025): Figure 7



Figure 7 Map of New Number Categories

- **Transition Numbers:** Represent intermediate forms evolving between states, processes without sharp boundaries.
- **Variable Numbers:** Dynamic values continuously updated depending on time and environmental factors.
- **Uniqueness Numbers:** Unique mathematical codes for each entity, challenging the idea that every "1" is always equal to another "1".
- **Equilibrium Numbers:** Critical values that ensure system stability and sustainability.
- **Symmetric and Asymmetric Numbers:** Represent ratios of geometric forms and biological structures in nature.
- **Half Numbers:** Express processes that do not reach completion or meaningful parts separated from a whole.
- **Constants:** Absolute, unchanging rules in nature.

8. Evolutionary Science as a Meta-Discipline

Natural Mathematics redefines evolution not merely as biological change but as a meta-science examining the transformation processes of all entities in the universe (Demirkus, 2023).

8.1. Chaisson's Cosmic Evolution

Eric Chaisson's theory of cosmic evolution provides empirical support for this perspective (Chaisson, 2001).

A key metric is the energy rate density (Φ_m), measured in erg/s/g—the rate of energy flow through a system per unit mass. Figure 8

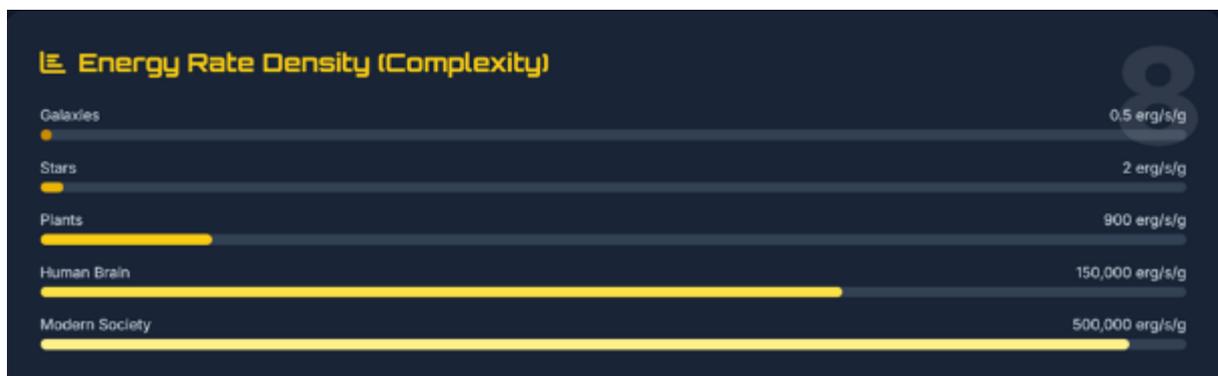


Figure 8 Energy Rate Density Graph

Chaisson shows that Φ_m increases significantly as the universe evolves:

- Galaxies: 0.5 erg/s/g

- Stars: 2 erg/s/g
- Plants: 900 erg/s/g
- Animals: 20,000 erg/s/g
- Human Brain: 150,000 erg/s/g
- Modern Society: 500,000 erg/s/g

This progression shows that cosmic evolution is an unbroken sequence of complexity from the Big Bang to human consciousness, with increasing energy rate density correlating with increasing complexity.

9. Infinity, Eternity, and the Technical Definition of Death

Natural Mathematics provides precise technical definitions that distinguish concepts often conflated in the literature: infinity and eternity (Demirkuş & Bilgin, 2018).

9.1. Infinity: Temporal Infinity

Infinity (∞) signifies unlimited expansion within a temporal process.

Key properties:

- Time exists and continues.
- Expansion can be unlimited but is still within defined space-set boundaries.
- Systems are mortal—subject to eventual radical change.

Cantor showed that there are different sizes of infinity. The set of real numbers has a greater cardinality (\aleph_1) than the set of natural numbers (\aleph_0), introducing the concept of uncountable infinity (Cantor, 1895). Figure 9

Feature	Infinity (∞)	Eternity
Time	Exists & continues	Non-existent / Halted
Speed	Limited	Eternal Speed
Change	Exists (Variable)	None (Immutable)
Formula	$t > 0$	$v \rightarrow \infty, t \rightarrow 0$

Figure 9 Infinity vs. Eternity Table

9.2. Eternity: Timelessness

Eternity represents a qualitatively different state where time approaches zero in a "molten" state.

Properties:

- Velocity reaches eternal speed, transcending infinity.
- Time effectively stops—there is no change.
- Systems are immortal—unchanging.
- All dimensions are interwoven via the "Velocity Glue."

The distinction can be expressed as: **As velocity $v \rightarrow \infty$, time $t \rightarrow 0$, approaching eternity.**

9.3. Mathematical Definition of Death

Mathematically, Death is defined as: The irreversible exit of a set element from the current set boundaries (space-time dimension) and a change of state (Demirkuş & Bilgin, 2018).

This definition aligns with the principle of conservation of energy. When creatures complete their life cycles, they return transformed energy to the universal energy pool.

In set-theoretic terms: if creature $c \in S$ (the set of living beings), death means $c \notin S$ and $c' \in S'$ (another state set).

10. The Functional Distinction Between Science and *Ilm* (Divine Knowledge)

Natural Mathematics makes a distinction between "Science" and "*Ilm*," positioning them in a hierarchical relationship (Demirkuş, 2016).

10.1. *Ilm*: Eternal and Absolute

Ilm occupies the highest stratum of the universal knowledge system.

Properties:

- Eternal, unchanging, and immortal.
- Contains knowledge of everything within and beyond nature.
- Encompasses all sciences, infinite cycles, everything knowable and unknowable.
- Concerned with intellect/reason.
- Its fruit in humans is good morality, wisdom, understanding. Figure 10



Figure 10 Science-Ilm Pyramid

10.2. Science: Temporal and Variable

Science serves as a tool for understanding the "nature" part within the pool of *Ilm*.

Properties:

- Variable, constantly changing and evolving.
- Mortal—will perish with the apocalypse.
- Limited—examines only creatures, events, processes in nature.
- Closely related to intelligence/database knowledge.
- Its fruit in humans is science, technology, communication tools.

This distinction aligns with John Polkinghorne's "bottom-up" thinking (Polkinghorne, 1998): Science answers "how" questions (mechanisms, processes), while *Ilm* answers "why" questions (purpose, meaning).

11. The Unity of Mathematics and Reality

The Natural and Universal Mathematics paradigm presents mathematics not merely as a tool but as the fundamental building block of reality. This approach: Figure 11

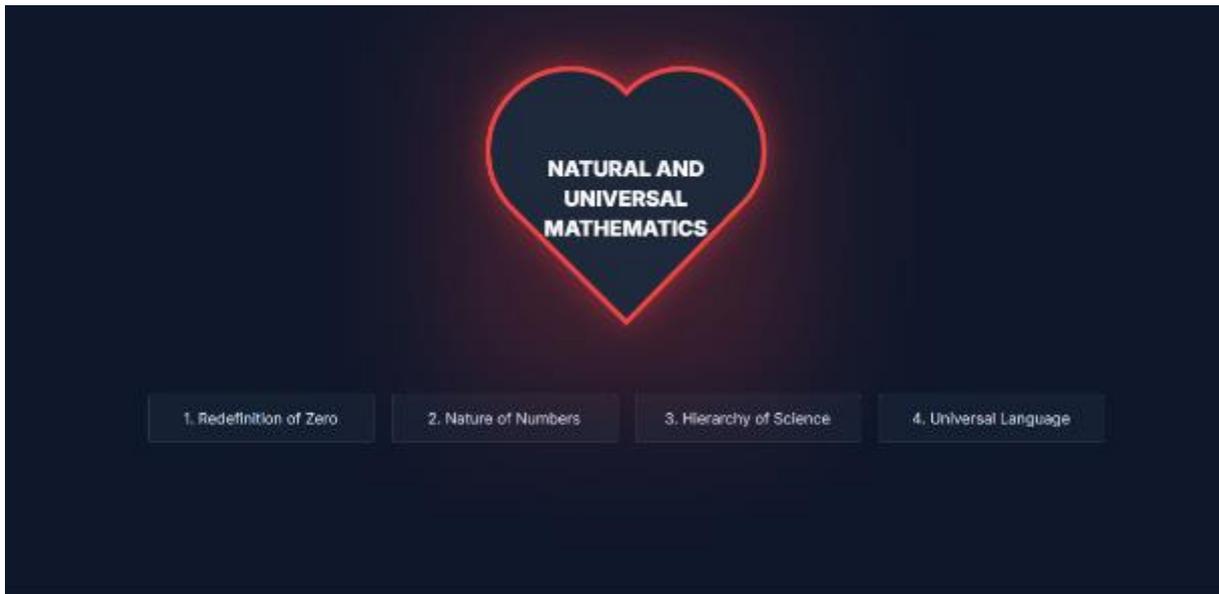


Figure 11 Natural Mathematics Paradigm

- **Places mathematics at the center of science:** $\text{Science} = \Sigma(\text{Scientific Disciplines} / \text{Mathematics})$
- **Redefines zero:** From nothingness to spatial boundaries.
- **Qualifies numbers:** Shift from quantity to quality.
- **Distinguishes infinity and eternity:** The difference between temporal infinity and timelessness.
- **Positions Science and *Ilm* hierarchically:** The temporal and variable versus the eternal and absolute.

This holistic approach expands the boundaries of scientific inquiry and offers interdisciplinary understanding by positioning mathematics as the language of the universe, the heart of science, and the foundation of existence. Figure 12

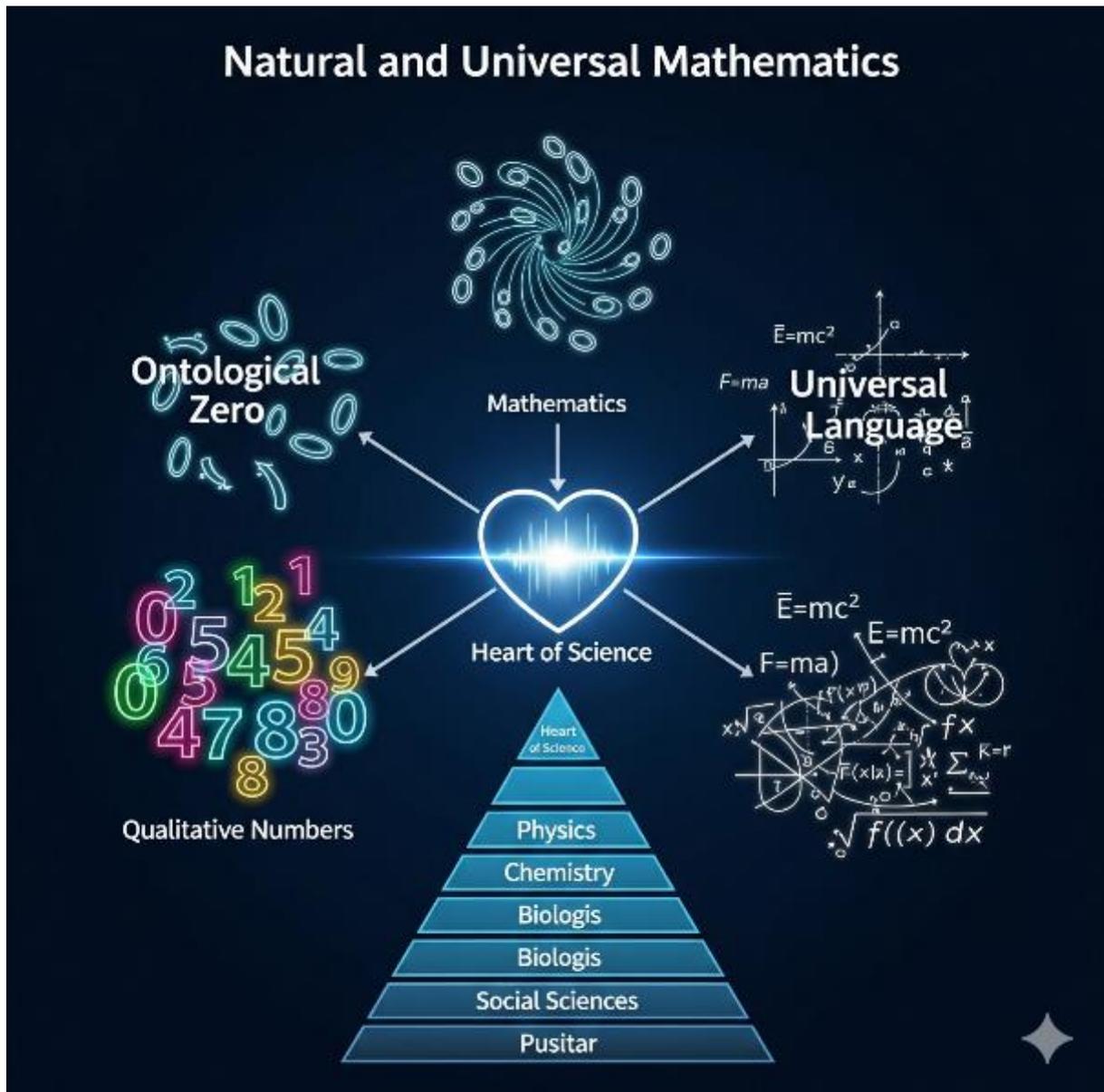


Figure 12 Natural and Universal Mathematics

Compliance with ethical standards

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The author declares no conflict of interest.

Statement of informed consent

Because this study did not include human participants, clinical interventions, personal data, or identifiable information, informed consent is not required. The informed consent statement has been submitted accurately (based on applicability).

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