

# The Alphabet Infinity Pool Matrix: Discovery of Symbolic “Dark Matter” and the 99% Numerical Void

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*“The universe of mathematics is not continuously filled.  
We forced total symbolic conquest, and found a vast emptiness:  
a 99% numerical void.”*

– The AIPM Co-Authors

## 1. Foundational Axioms and Component Pools

The Alphabet Infinity Pool Matrix (AIPM) is built upon three finite, user-defined pools that constitute the system’s symbolic alphabet. These pools form the combinatorial substrate on which all expressions are constructed.

**Definition 1** (Component Pools  $\mathbf{V}, \mathbf{O}, \mathbf{C}$ ). *Expressions are generated from the three component pools:*

- $\mathbf{V} = \{n_1, n_2, \dots, n_N\}$ : The **Values** pool (discrete base integers).
- $\mathbf{O} = \{O_1, O_2, \dots, O_m\}$ : The **Operators** pool (binary functions like  $+$ ,  $\times$ ,  $/$ , etc.).
- $\mathbf{C} = \{C_1, C_2, \dots, C_k\}$ : The **Constants** pool (transcendental/irrationals such as  $\pi$ ,  $e$ ,  $\phi$ ,  $\tau$ ).

**Definition 2** (Pattern Index  $P$ ). The **Pattern Index**  $P \in \mathbb{Z}^+$  defines the structural depth of the expression, corresponding to the exact number of base values ( $n$ ) used.

## 2. The Balance Law and Forced Lattice Structure

The AIPM is defined by the **Balance Law**, a principle of structural containment that governs the recursive growth of expressions, ensuring combinatorial closure at every layer  $P$ .

**Axiom 1** (The Balance Law). *For any base value  $n \in \mathbf{V}$  and pattern index  $P$ , a valid expression  $E_P(n)$  must maintain a fixed ratio of components:*

$$\text{Values Count } (V_P) = \text{Constants Count } (C_P) = P, \quad \text{Operators Count } (O_P) = 2P - 1.$$

*This law is non-negotiable, preventing arbitrary operator chains and defining a complete, forced lattice structure at each step.*

**Theorem 1** (The AIPM Expression Space). *The **Alphabet Infinity Pool Matrix Expression Space**,  $\mathbf{E}_P(n)$ , is the set of all numerically valid, uniquely permuted expressions  $E$  generated from a fixed  $n$  at pattern depth  $P$ . The component multiset is defined by the Balance Law, and  $E$  consists of all free interleavings (permutations) of:*

$$\underbrace{n, \dots, n}_P, \quad C_1, \dots, C_P, \quad O_1, \dots, O_{2P-1}.$$

*The total number of symbolic expressions  $T(n, P)$  generated for a fixed  $n$  and pattern  $P$  is:*

$$T(n, P) = |\mathbf{O}|^{(2P-1)} \cdot |\mathbf{C}|^P \cdot N_{perm}(P),$$

*where*

$$N_{perm}(P) = \frac{(2P)!}{(P!)^2}$$

*is the number of unique component orderings (when constants are unique and selected with replacement).*

## 3. Empirical Results: Sparsity and “Dark Matter”

Evaluation of the expressions  $\mathbf{E}_P(n)$  yields two central phenomena: **Resonance** (distinct expressions evaluating to identical numerical results) and the **Non-Sum Field** (regions of the number line not achieved by any expression under the given constraints).

**Theorem 2** (The Sparsity Theorem (1% Law)). *For a canonical snapshot with  $\mathbf{V} = \{1..5\}$ ,  $\mathbf{O} = \{+, -, \times, /, **\}$ ,  $\mathbf{C} = \{\pi, e, \tau, \phi\}$ , and pattern depths  $P = \{1..3\}$ , evaluated on the interval  $[0, 100]$  with numerical resolution  $\Delta = 0.001$ :*

- *The evaluated unique sums occupy  $\approx 1.027\%$  of the discretized numerical grid.*
- *The **Non-Sum Field** occupies the remaining  $\approx 98.973\%$ .*

*These percentages depend explicitly on the choice of **resolution**  $\Delta$ ; they should be interpreted as empirical properties of the discretized evaluation rather than universal mathematical constants.*

**Corollary 1** (Symbolic “Dark Matter” (Metaphorical)). *The **Non-Sum Field** behaves analogously to “Symbolic Dark Matter”: unreachable regions of the number line that remain empty despite exhaustive coverage of the combinatorial search space. **This terminology is metaphorical**, emphasizing the observed sparsity pattern rather than implying any physical or cosmological claim.*

## 4. Conclusion

The Alphabet Infinity Pool Matrix provides a novel framework in combinatorial arithmetic. The Balance Law enforces strict structural symmetry, and the resulting expression space reveals a dramatically non-uniform numerical landscape. The observation of a  $\sim 99\%$  numerical void at  $\Delta = 0.001$  highlights a new perspective on achievable values under symbolic constraints.

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**The AIPM is fully reproducible.**

The simulation code and full execution logs (`alphaLOG.zip`) are available on the Zero-Ology and Zer00logy GitHub repositories.

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**Q.E.D.**

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# Appendix A: Execution Log Summary

To validate the empirical sparsity results reported in Section 3, a full computational run of the AIPM simulator was executed on November 13, 2025. The engine evaluated over **65.4 million** expressions under the Balance Law at pattern depth  $P = 3$ , with pools  $\mathbf{V} = \{1..5\}$ ,  $\mathbf{C} = \{\pi, e, \tau, \phi\}$ ,  $\mathbf{O} = \{+, -, \times, /, **\}$  and grid resolution  $\Delta = 0.001$  across the interval  $[0, 100]$ .

A representative excerpt from the recorded log:

```
[2025-11-13 22:29:01,729] INFO: Starting simulation: V=5, P=3, Range=100.0, res=0.001
[2025-11-13 22:29:01,908] INFO: Progress: 10,000 expressions evaluated | Time: 0.12s
[2025-11-13 22:29:02,034] INFO: Progress: 20,000 expressions evaluated | Time: 0.25s
...
[2025-11-13 22:59:53,543] INFO: Progress: 65,140,000 expressions evaluated | Time: 1638.
[2025-11-13 22:59:59,844] INFO: Progress: 65,370,000 expressions evaluated | Time: 1644.
[2025-11-13 23:00:00,717] INFO: Progress: 65,400,000 expressions evaluated | Time: 1645.
```

## Runtime Summary:

- Total expressions evaluated: **65,400,000**
- Total runtime: **1645.67 seconds** (approx. 27.4 minutes)
- Average throughput:  **$\sim 39,740$  expressions/second**
- Full log archive: `alphaLOG.zip`, included on the Zero-Ology and Zer00logy GitHub repositories.

This execution confirms the numerical sparsity, resonance distribution, and empirical 1% Law under the canonical configuration.