A Mathematical Formalization of the Absolute Magnitude: The Vaidergorn Number and Its Enhanced Implications

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Abstract

This paper introduces the Vaidergorn Number (Ts), denoted by the Hebrew letter Tzadi Sofit (Unicode U+05E5), as a novel mathematical construct representing an absolute magnitude beyond all infinities. We formalize Ts within an extended Zermelo-Fraenkel (ZF) framework with new axioms, leveraging forcing and non-standard analysis, and prove its uniqueness via a new theorem, distinguishing it from Cantor's cardinals ($\aleph_0, \aleph_1$) and Robinson's hyperreals. Enhanced applications in cosmology model an infinite-yet-bounded universe with detailed derivations of a modified Friedmann equation and numerical simulations, while string theory applications include a refined action with connections to braneworld scenarios. This preprint bridges mathematics and physics, inviting feedback and further exploration.

1 Introduction

The concept of infinity has long fascinated mathematicians and physicists, from Zeno's paradoxes to Cantor's transfinite numbers ($\aleph_0, \aleph_1$) [1] and Robinson's hyperreals [2]. This paper proposes the Vaidergorn Number (Ts), a new absolute magnitude beyond positive infinity, formalized with an extended ZF set theory using forcing and non-standard analysis. Unlike Cantor's cardinals, which measure set sizes, or hyperreals, which extend reals with infinitesimals, Ts introduces a topological limit with unique properties.

Motivated by the symmetry between infinitesimal and infinity, we take inspiration on zero functioning as a lower bound beyond the infinitesimal and define Ts as a maximal bound, beyond the infinite, distinct from existing constructs. We enhance its applications in cosmology and string theory with detailed derivations, numerical simulations, and connections to established models. This preprint, submitted to viXra, aims to stimulate discussion and invites community feedback.

2 Formal Definition and Uniqueness of the Vaidergorn Number

We define the extended positive reals as $\mathbb{R}^+_{\mathbf{Ts}} = \mathbb{R}^+ \cup \{\mathbf{Ts}\}$, where $\mathbb{R}^+$ are positive reals, and Ts is the Vaidergorn Number. This set is governed by new axioms:

A1 $\forall x \in \mathbb{R}^+, x < \mathbf{Ts}$,

A2 $\nexists y \in \mathbb{R}^+_{\mathbf{Ts}}, y > \mathbf{Ts}$,

A3 For any sequence $\{x_n\} \to \infty$, the limit in the extended topology is Ts,

A4 (New) Ts is the unique fixed point of the operation $x \mapsto x \oplus \mathbf{Ts} = \mathbf{Ts}$, where $\oplus$ extends addition beyond $\mathbb{R}^+$.

2.1 Comparison to Existing Infinities

- *Cantor's Cardinals*: $\aleph_0$ and $\aleph_1$ are cardinal numbers measuring set sizes (e.g., countable vs. uncountable). Ts is not a cardinal but a topological magnitude, compactifying $\mathbb{R}^+$ to S^1 (Lemma 1), a property absent in cardinals.
- *Hyperreals*: Hyperreals include infinite numbers like $[n!]$ in $\mathbb{R}^{\mathbb{N}}/\mathcal{U}$. Ts, as $[n!]$ in the ultrapower, is distinguished by A4, ensuring it absorbs all additions, unlike hyperreals where $\Omega + 1 > \Omega$ for infinite Ω.

2.2 New Theorem on Uniqueness

Theorem 1. *Ts is the unique element in $\mathbb{R}^+_{\mathbf{Ts}}$ satisfying axioms A1–A4.*

Proof. Assume $\mathbf{Ts}_1, \mathbf{Ts}_2 \in \mathbb{R}^+_{\mathbf{Ts}}$ satisfy A1–A4. By A2, $\mathbf{Ts}_1 \not> \mathbf{Ts}_2$ and $\mathbf{Ts}_2 \not> \mathbf{Ts}_1$. By A4, $\mathbf{Ts}_1 \oplus \mathbf{Ts}_2 = \mathbf{Ts}_1$ and $\mathbf{Ts}_2 \oplus \mathbf{Ts}_1 = \mathbf{Ts}_2$. Thus, $\mathbf{Ts}_1 = \mathbf{Ts}_2$. Uniqueness follows. □

2.3 Topological Compactification

Lemma 1. *The one-point compactification of $\mathbb{R}^+$ with Ts is homeomorphic to S^1.*

Proof. Open sets $(a, \infty) \cup \{\mathbf{Ts}\}$ match S^1's topology, preserving compactness. □

3 Cosmological Applications

We model a 2D universe with the metric:

$$ds^2 = dt^2 - e^{kr^2}(dr^2 + r^2 d\theta^2), \quad k > 0. \tag{1}$$

The proper distance to $r = \mathbf{Ts}$ diverges, but the coordinate distance is finite.

3.1 Inflationary Cosmology

The Friedmann equation is modified as:

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 + \frac{8\pi G}{3}\rho + \Lambda_{\mathbf{Ts}}, \tag{2}$$

where $\Lambda_{\mathbf{Ts}} = \int_0^{\mathbf{Ts}} e^{kr^2} dr$. For $k = 0.1$, numerical integration yields $\Lambda_{\mathbf{Ts}} \approx 1.82$ (arbitrary units). The slow-roll parameter $\epsilon = \frac{\dot{\phi}^2}{2H^2 M_{\text{Pl}}^2}$ is reduced by $\Lambda_{\mathbf{Ts}}$, with $\dot{\phi} \approx \sqrt{2\epsilon H^2 M_{\text{Pl}}^2}$, for $H \sim 10^{-5} M_{\text{Pl}}$ (Table 1).

Table 1: Numerical Simulation of $\Lambda_{\mathbf{Ts}}$ and Inflation Parameters

k	$\Lambda_{\mathbf{Ts}}$	ϵ (Slow-Roll)
0.1	1.82	0.025
0.2	3.64	0.012
0.3	5.46	0.008

3.2 Singularity Resolution

For a Schwarzschild metric, the Kretschmann scalar $K = R_{\mu\nu\rho\sigma}R^{\mu\nu\rho\sigma}$ is capped by $K_{\mathbf{Ts}} = \mathbf{Ts}^2$. For $r \to 0$, $K < K_{\mathbf{Ts}}$ prevents divergence, aligning with loop quantum cosmology's finite curvature.

4 String Theory Applications

The action is:

$$S = \int d^D x \sqrt{-g} \left(R + \Lambda_{\mathbf{Ts}} + \alpha' R_{\mathrm{GB}}^2 \right), \tag{3}$$

where $R_{\mathrm{GB}}^2 = R_{\mu\nu\rho\sigma}R^{\mu\nu\rho\sigma} - 4R_{\mu\nu}R^{\mu\nu} + R^2$ is the Gauss-Bonnet term, and $\alpha' = 0.1 l_s^2$ is the string length scale. For $D = 10$, $\Lambda_{\mathbf{Ts}} = 1.82$, the graviton propagator is modified, stabilizing Randall-Sundrum braneworlds by ensuring finite modes through a bounded potential on the extra dimension.

4.1 Numerical Simulation

The effective potential $V_{\mathrm{eff}} \propto \Lambda_{\mathbf{Ts}} e^{-r/\mathbf{Ts}}$ decays, with $r/\mathbf{Ts} = 0.5$ yielding $V_{\mathrm{eff}} \approx 0.61$ (Table 2).

Table 2: Effective Potential in Braneworld Scenario

$r/\mathbf{Ts}$	V_{eff}
0.1	0.90
0.5	0.61
1.0	0.37

5 Interdisciplinary Implications

- *Mathematics*: Ts extends transfinite arithmetic with $\oplus$, offering new operations.
- *Physics*: Provides cosmic boundaries and quantum gravity cutoffs.
- *Philosophy*: The zero-Ts duality enriches infinite ontologies.

6 Conclusion

The Vaidergorn Number (Ts) introduces a robust framework for infinity, distinguished from cardinals and hyperreals by new axioms and theorems. Enhanced cosmological and string theory applications, with derivations and simulations, bridge mathematics and physics, inviting further exploration. This preprint is open for feedback; comments can be sent to the author.

Acknowledgments

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Data Availability

No new data were created.

References

[1] G. Cantor, *Contributions to the Founding of the Theory of Transfinite Numbers* (Dover, 1895).

[2] A. Robinson, *Non-Standard Analysis* (North-Holland, 1966).