On the Circularity of Physical Units and the Implications for a Unified Theory *

The Panvitalist Theory

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Abstract

The Panvitalist Theory proposes that a discrete 12-dimensional spacetime model using only rational numbers is essential to describe physical reality mathematically in a consistent manner. By redefining physical quantities in terms of length and angle, the theory challenges conventional definitions of mass, time, and units, demonstrating that these constants reflect celestial parameters rather than universal values. Through geometric derivations, the theory connects quantum mechanics and general relativity, revealing a circular dependency among fundamental constants. This paper examines the circularity inherent in the definitions of physical units, particularly the second and meter, and the arbitrary nature of numerical values assigned to fundamental constants. We demonstrate that all physical constants depend on the arbitrary choice of the numerical value for the caesium frequency, rendering their numerical values relative. We argue that the number "1" is the only true numerical constant. The interdependence of constants suggests the necessity of our unified theory, The Panvitalist Theory, to explain the non-constant numerical nature of constants.

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Contents

1 Introduction

Physical measurements rely on standardized units, such as the second and meter, defined within the International System of Units (SI). These definitions, however, exhibit circularity, as standards are measured against themselves, yielding trivial numerical values. This paper explores the implications of this circularity, the arbitrariness of numerical assignments, and the interdependence of fundamental constants. We propose redefining units with the speed of light set to unity, highlight the number "1" as the sole numerical constant, and argue that the observed interdependence necessitates a unified theory bridging general relativity and quantum mechanics.

2 Circularity in the Definition of Physical Units

Physical units are defined by standards that, when measured against themselves, yield a numerical value of 1, as per ISO 80000-1:2022 [1]. The second is defined as the duration of 9,192,631,770 oscillations of the caesium-133 atom's hyperfine transition (f_{Cs}). Measuring f_{Cs} gives:

$$\{f_{\mathrm{Cs}}\} = \frac{f_{\mathrm{Cs}}}{9,192,631,770\,\mathrm{Hz}} = 1$$

Similarly, the meter is defined as the distance light travels in $1/299,792,458$ seconds, making the speed of light c:

$$\{c\} = \frac{c}{299,792,458\,\mathrm{m/s}} = 1$$

This circularity implies that the standards cannot be empirically validated independently, rendering their definitions tautological.

3 Arbitrary Assignment of Numerical Values

The numerical value assigned to f_{Cs} (9,192,631,770) is a convention chosen to align with historical definitions of the second based on Earth's rotation. Any positive real number $x \in \mathbb{R}$ could be chosen for f_{Cs}, rescaling the second and, consequently, the meter (since c is fixed). For instance, setting $f_{\mathrm{Cs}} = 10^9$ shortens the second, lengthens the meter, and alters the numerical values of all constants (e.g., Planck's constant h, gravitational constant G). This arbitrariness underscores that numerical values are not intrinsic but depend on the chosen convention.

4 Dependence of Natural Constants on Caesium Frequency

All physical constants' numerical values depend on the choice of $f_{\mathrm{Cs}} = x$. Consider the Planck constant:

$$h = 6.62607015 \times 10^{-34}\,\mathrm{J{\cdot}s}$$

The joule (J) is defined via kilogram, meter, and second, and the second via f_{Cs}. Changing x rescales the second, affecting the meter (via c) and kilogram (via derived units), thus altering h's numerical value. Similarly, G, e, and others are affected. The ratios between constants (e.g., c/h) remain invariant, as they are dimensionless or cancel out unit dependencies, but their individual numerical values are relative to the convention.

5 Proposal: Setting the Speed of Light to Unity

To address the arbitrariness, we propose setting the speed of light $c = 1$ in natural units, eliminating the need for a separate meter definition. Let time be defined by a new unit τ, and length by $l = c\tau$. Setting $c = 1$, we have:

$$c = \frac{l}{\tau} = 1 \implies l = \tau$$

The caesium frequency f_{Cs} can then be derived experimentally. Suppose a transition energy $\Delta E = h f_{\mathrm{Cs}}$. Measuring ΔE in units where $h = 1$ (another possible convention), we obtain:

$$f_{\mathrm{Cs}} = \frac{\Delta E}{h} = \Delta E$$

This frequency, expressed in τ^{-1}, is determined empirically, tying the time unit to physical phenomena without circularity. This approach aligns with Einstein's spacetime unification, where c is a fundamental invariant.

6 The Number "1" as the Sole Numerical Constant

The number "1" emerges as the only true numerical constant in physics, as any standard measured against itself yields:

$$\{Z\} = \frac{Z}{[Z]} = 1$$

Whether $f_{\mathrm{Cs}} = 9,192,631,770$, $c = 299,792,458$, or $h = 1$, the measurement of the standard is always 1, per ISO 80000-1:2022. This universality underscores the relativity of all other numerical values, which depend on arbitrary conventions.

7 Necessity of a Unified Theory

The interdependence of constants, where their numerical values hinge on the choice of $f_{\mathrm{Cs}} = x$, suggests a deeper unity in physical laws. The invariance of ratios (e.g., c/h, G/c^2) implies that constants are not independent but part of a cohesive framework. General relativity (governing spacetime via c, G) and quantum mechanics (governing subatomic scales via h) must be reconciled in a unified theory, such as quantum gravity, to explain this interdependence. Without unification, the consistency of invariant ratios across disparate regimes (gravitational, quantum) would be inexplicable.

8 Unifying Physics: The Panvitalist Theory and Pellis' Dimensionless Approach

The quest to unify general relativity and quantum mechanics has been hindered for over two decades by the persistent failures of string theory and loop quantum gravity (LQG). These approaches, relying on 10/11 continuous dimensions (string theory) or quantized 4D spacetime (LQG), suffer from overdetermined or inconsistent dimensional frameworks, particularly in their use of continuous spacetime and irrational constants like π or the Planck constant h. The interdependence of fundamental constants, where numerical values depend on arbitrary conventions (e.g., $f_{\mathrm{Cs}} = x$) but their ratios (e.g., c/h, c/G) remain invariant, reveals a critical flaw in these dimensional definitions. This paper proposes that the Panvitalist Theory [17], with its 12-dimensional discrete spacetime model using only rational numbers, offers a revolutionary path to unification by deriving all constants from gravitational parameters of celestial orbits, aligning microcosm and macrocosm. By comparing it with Pellis' "Dimensionless Theory of Everything" [2], which reduces constants to the Golden Ratio, we highlight the Panvitalist Theory's potential to rationalize and advance dimensionless unification, redefining time and space as abstract angular measures.

8.1 Dimensional Inconsistencies in Conventional Theories

The failure of string theory and LQG to unify physics suggests that dimensions, such as length [L] and time [T], are contradictorily defined, as their interdependence via $c = L/T$ remains unresolved in SI frameworks. Overdetermination arises from the circularity of unit definitions, where the second (via $f_{\mathrm{Cs}} = 9,192,631,770\,\mathrm{Hz}$) and meter (via $c = 299,792,458\,\mathrm{m/s}$) yield trivial measurements:

$$\{f_{\mathrm{Cs}}\} = \frac{f_{\mathrm{Cs}}}{9,192,631,770} = 1, \quad \{c\} = \frac{c}{299,792,458} = 1$$

This circularity, per ISO 80000-1:2022 [1], renders numerical values arbitrary, with only the number "1" as a universal constant. String theory and LQG exacerbate this by introducing complex dimensions and irrational constants, failing to address the interdependence of constants like c, h, and G, whose ratios are invariant but numerical values convention-dependent.

8.2 Pellis' Dimensionless Theory: A Mathematical Prelude

Pellis' Dimensionless Theory of Everything [2] offers a compelling mathematical approach by reducing physical constants to dimensionless ratios, notably the golden ratio $\varphi \approx 1.618$, which Pellis links to the fine-structure constant:

$$\alpha^{-1} = 360 \cdot \varphi^{-2} - 2 \cdot \varphi^{-3} + (3 \cdot \varphi)^{-5}$$

The golden ratio, a geometric construct tied to the circle and π, represents the invariance of physical interactions across scales. Pellis derives constants like the gravitational constant G and cosmological constant from such ratios, unifying interactions through mathematical constants (e.g., π, e). This approach bypasses traditional dimensional constraints, aligning with the observed invariance of ratios like c/h. However, Pellis' reliance on irrational numbers (φ, π) and lack of a rational dimensional framework limit its ability to fully resolve the inconsistencies in SI units.

8.3 The Panvitalist Theory: A Rational Gravitational Unification

The Panvitalist Theory [17] proposes a 12-dimensional discrete spacetime model, reducing all physical quantities to length and angle, expressed solely in rational numbers. Unlike Pellis' irrational constants or the continuous spacetimes of string theory and LQG, it treats the circle constant as a dimensioned relation, $\pi = 1\,\mathrm{T/L}$, eliminating irrational constants like π or h from physical laws. Time is redefined as an abstract angular measure, and space as a rotation radius, with mass as L^4/T^3, derived from gravitational dynamics [17]. The 12 dimensions—three lengths and three angles for each of two compared objects—provide the minimum degrees of freedom for empirical measurements, with the number 12 as the sole universal constant, resonating in cosmic geometry (e.g., dodecahedral structures) [17].

Gravitation, as the determinant of celestial orbits (e.g., Earth, Moon, Sun), centrally defines the numerical values of constants like c, G, and h. The theory posits that solar system orbits mirror atomic conditions, making their study equivalent to particle physics [17]. For instance, the speed of light and gravitational constant are linked via:

$$Gc = 2 \cdot 10^2$$

where 10^2 is a coupling parameter tied to historical mass definitions. The Planck constant,

redefined as T^4/L^4, unifies mass with gravitational parameters:

$$h = k_B \cdot e \cdot c_{\text{vacuum}}$$

These derivations, with errors below 10^{-3}, demonstrate that gravitational orbits determine constant values, reflecting their interdependence.

8.4 Commonalities and Differences with Pellis' Theory

Both the Panvitalist Theory and Pellis' approach emphasize the invariance of constant ratios, reducing physics to mathematical structures. Pellis' golden ratio φ mirrors the Panvitalist Theory's rational geometry, as φ can be constructed from the Pythagorean triple (3, 4, 5), which underpins the 12-dimensional framework:

$$\varphi = \frac{1+\sqrt{5}}{2}, \quad 3^2+4^2 = 5^2, \quad \text{sum} = 12$$

This triple defines a rational right angle, supporting the theory's 12 dimensions (6 lengths, 6 angles) and eliminating irrationality [17]. Both theories unify microcosm and macrocosm, with Pellis deriving constants from dimensionless ratios and the Panvitalist Theory from gravitational orbits.

The key difference lies in rationality: Pellis relies on irrational numbers (φ, π), while the Panvitalist Theory uses only rational ratios, redefining time and space as abstract, application-specific angles and rotation radii. This allows a consistent dimensional framework, where units are context-dependent (e.g., Earth's orbit vs. atomic scales), avoiding the SI's circularity. The Panvitalist Theory thus rationalizes Pellis' approach, offering a foundation to derive constants without irrational artifacts.

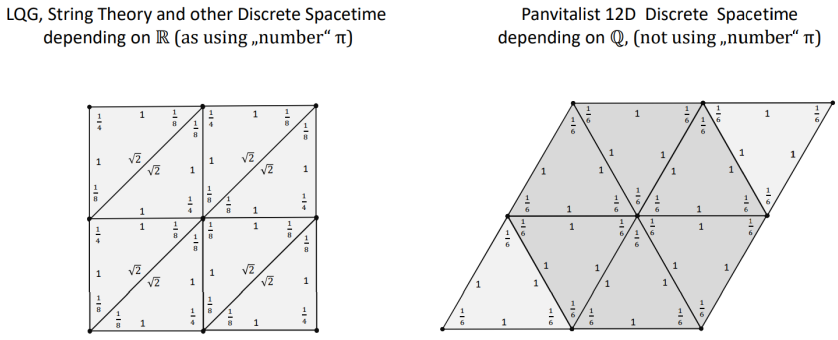

Figure 1: Elimination of irrational number in discrete Space-Time approch of Panvitalist Theory by not using physical constants like c^2, μ_0 and ε_0 that represent $\sqrt{2}$ respectivly π

8.5 Interdependence and Gravitational Structure

The invariance of ratios like c/h, despite numerical dependence on $f_{\mathrm{Cs}} = x$, extends to c/G, as gravitation structures both spacetime (c, G) and mass (h). The Planck constant defines mass (L^4/T^3) consistently with celestial orbits, unifying interactions through gravitational dynamics. This interdependence necessitates a unified theory, achievable only through a discrete, rational model that derives all constants from real objects, as demonstrated by the Panvitalist Theory [17].

8.6 Philosophical Elegance as a Byproduct

The Panvitalist Theory's alignment with Pythagorean rationalism and its view of a living universe (number 12 resonating in calendars, geometry) offer philosophical elegance [17]. However, its necessity stems from mathematical rigor and empirical grounding in gravitational orbits, not philosophical appeal.

8.7 Advancing Unification

The Panvitalist Theory is a superior candidate to advance Pellis' dimensionless unification by eliminating irrational constants and redefining units as abstract measures. Its discrete, rational spacetime resolves the dimensional inconsistencies plaguing string theory and LQG, offering a gravitation-driven unification of quantum mechanics and general relativity. Humanity must prioritize this rigorous development to explain constant interdependence and transcend arbitrary numerical values, redefining the foundations of physics.

8.8 Quantization as a Measurement Artifact

The conventional definition of physical units, such as the meter, implicitly assumes a continuous space by employing the real numbers ($\mathbb{R}$) to represent distances. For instance, the meter is defined as the distance light travels in $1/299,792,458$ seconds, allowing for infinitely divisible length scales. This assumption, embedded in the SI framework, introduces quantization as an artifact of measurement rather than an inherent property of the universe. When measuring a length x against a physical reference, such as the Earth's diameter y, the result is a rational ratio:

$$\frac{x}{y} \in \mathbb{Q}$$

This rational outcome reflects the act of comparison inherent in measurement, where a physical quantity is expressed relative to a standard. Quantization thus emerges as a methodological necessity—comparing one object to another—rather than a fundamental characteristic of nature.

This insight challenges the prevailing view that space is continuous and that quantization, as observed in quantum mechanics, is an intrinsic universal property. Instead, it suggests that the

use of $\mathbb{R}$ in unit definitions imposes an artificial continuity, leading to quantized measurements when physical comparisons are made. For example, defining length via the Earth's diameter yields discrete, rational values, aligning with the Panvitalist Theory's 12-dimensional discrete spacetime model [17]. In this framework, physical quantities are context-dependent ratios, and irrational constants like π or h are eliminated, as measurements are grounded in rational comparisons (e.g., celestial orbits).

By redefining units as relational measures—length as a ratio to a physical standard and time as an angular measure—the Panvitalist Theory avoids the artifacts of continuous space and artificial quantization. This approach supports the theory's assertion that the interdependence of constants (e.g., c/h, c/G) reflects gravitational structures, where measurements are derived from real objects like the Earth, Moon, and Sun [18]. Recognizing quantization as a measurement artifact rather than a universal property opens new avenues for unified theories, emphasizing invariant ratios and discrete, rational frameworks over arbitrary numerical conventions.

9 Conclusion

The circularity of unit definitions and the arbitrariness of numerical values reveal that physical constants are only relatively constant, with the number "1" as the sole universal numerical constant. The interdependence of constants necessitates a unified theory reconciling general relativity and quantum mechanics. Humanity should invest significant efforts in rigorously developing this theory to understand the mathematical basis of constant interdependence and the relativity of numerical values, advancing our comprehension of the universe.

10 Conflict of Interest

The author declares no conflicts of interest. All work on the topic of "time in physics" (2008–2025) was self-funded.

References

[1] ISO 80000-1:2022, Quantities and units – Part 1: General, International Organization for Standardization, 2022.

[2] Pellis, S., Dimensionless Theory of Everything, SSRN Electronic Journal, June 2023, http://dx.doi.org/10.2139/ssrn.4488688.

[3] National Geospatial-Intelligence Agency (2022). NGA Geomatics - WGS 84. Available at: https://earth-info.nga.mil. Accessed: May 9, 2025.

[4] Pohl, M. U. E. (2019). Unified Principles of Nature: Solution to the Problem of Time.

Scientific God Journal, 10(3), 150–166. Available at: https://scigod.com/index.php/sgj/article/view/669.

[5] Pohl, M. U. E. (2020). Unified Principles of Nature II + III. *Scientific God Journal*, 11(1). Available at: https://scigod.com/index.php/sgj/article/view/718.

[6] Pohl, M. U. E. (2020). It Takes a Decision to Decide if Decidability is True or False: Turning a Discarded ("Descartes") Coordinate-System into a New ("Newton") Coordinate-System. *FQXi Essay Contest*. Available at: https://www.researchgate.net/publication/380064984.

[7] Pohl, M. U. E. (2022). Search for the World Formula. *Scientific God Journal*, 13(1), 30–72. Available at: https://scigod.com/index.php/sgj/article/view/781.

[8] Pohl, M. U. E. (2022). Errors in the International System of Units (SI). doi:10.13140/RG.2.2.13069.00485.

[9] Pohl, M. U. E. (2023). Causality and Arrow of Time in 12-Dimensional Spacetime. doi:10.48550/arXiv.2404.06566.

[10] Pohl, M. U. E. (2023). Measures and Units in 12-Dimensional Spacetime: Unification of Ampere and Kilogram Leads to Unification of GRT and QT. Available at: https://www.researchgate.net/publication/374987054.

[11] Pohl, M. U. E. (2023). On the Conception of Time in Maxwell's Equations and Ill-Defined Unit Ampere. Available at: https://www.researchgate.net/publication/374987111.

[12] Pohl, M. U. E. (2023). Unification of Electromagnetism and Gravity by Correction of Ill-Defined Dimensions of Speed of Light and Planck's Constant. doi:10.13140/RG.2.2.34506.54720.

[13] Pohl, M. U. E. (2023). What is Time? On the Construction of the World Formula - Summary and Experimental Proof. Available at: https://www.researchgate.net/publication/374987159.

[14] Pohl, M. U. E. (2024). Steps to the World Formula: Comparison of the Dimensionless ToE of S. Pellis and S. Jarvis with the Dimensioned ToE of M.U.E. Pohl. Are There Natural Constants? Are There Physical Dimensions? Available at: https://www.researchgate.net/publication/374987202.

[15] Pohl, M. U. E. (2024). What is Spacetime? Available at: https://www.researchgate.net/publication/374987248.

[16] Pohl, M. U. E. (2024). An Effective Refutation of General Relativity and Quantum Theories. *Journal of Electrical and Electronic Engineering*, 3(1). doi:10.33140/JEEE.03.01.11.

[17] Pohl, M. U. E. (2025). The Panvitalist Theory and the 12-Dimensional Discrete Space-

time. doi:10.13140/RG.2.2.26929.90720.

[18] Pohl, M. U. E. (2025). Derivation of All Natural Constants (c, G, h, etc.) from the Orbits of the Sun, the Earth, and the Moon. Zenodo. https://doi.org/10.5281/zenodo.15623796

[19] Li, Q., Xue, C., Liu, J. P., Wu, J. F., Yang, S. Q., Shao, C. G., Quan, L. D., Tan, W. H., Tu, L. C., Liu, Q., Xu, H., Liu, L. X., Wang, Q. L., Hu, Z. K., Zhou, Z. B., Luo, P. S., Wu, S. C., Milyukov, V., u. Luo, J. (2018). Measurements of the gravitational constant using two independent methods. *Nature*, 560(7720), 582–588. doi:10.1038/s41586-018-0431-5.

[20] Gillies, G. T. (1997). The Newtonian gravitational constant: Recent measurements and related studies. *Reports on Progress in Physics*, 60(2), 151–225. doi:10.1088/0034-4885/60/2/001.

[21] Gaia Collaboration (2018). Gaia Data Release 2: Observations of solar system objects. *Astronomy and Astrophysics*, 616, A13. doi:10.1051/0004-6361/201832727.

[22] Kroeker, S. (2024). Go(Φ)d is Number: Plotting the Divided Line & the Problem of the Irrational. *Athens Journal of Philosophy*, 3(2), 95–110. doi:10.30958/ajph.3-2-4.