

The Hidden Secret of 1/137

Johann Pascher

2025

The Hidden Secret of 1/137

1 The Century-Old Riddle

1.1 What Everyone Knew

For over a century, physicists have recognized the fine-structure constant $\alpha = 1/137.035999...$ as one of the most fundamental and enigmatic numbers in physics.

Historical Recognition

- **Richard Feynman (1985):** "It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it."
- **Wolfgang Pauli:** Was obsessed with the number 137 his entire life. He died in hospital room number 137.
- **Arnold Sommerfeld (1916):** Discovered the constant and immediately recognized its fundamental importance for atomic structure.
- **Paul Dirac:** Spent decades trying to derive α from pure mathematics.

1.2 The Traditional Perspective

The conventional understanding was always:

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c} = \frac{1}{137.035999...} \quad (1)$$

This was treated as:

- A fundamental input parameter
- An unexplained natural constant
- A number that simply exists
- Subject of anthropic principle arguments

2 The New Reversal

2.1 The T0 Discovery

The T0 Theory reveals that everyone had been looking at the problem backwards. The fine-structure constant is not fundamental - it is **derived**.

The Paradigm Shift

Traditional View:

$$\frac{1}{137} \xrightarrow{\text{mysterious}} \text{Standard Model} \xrightarrow{19 \text{ Parameters}} \text{Predictions} \quad (2)$$

T0 Reality:

$$3\text{D Geometry} \xrightarrow{\frac{4}{3}} \xi \xrightarrow{\text{deterministic}} \frac{1}{137} \xrightarrow{\text{geometric}} \text{Everything} \quad (3)$$

2.2 The Fundamental Parameter

The truly fundamental parameter is not α , but:

$$\xi = \frac{4}{3} \times 10^{-4} \quad (4)$$

This parameter emerges from pure geometry:

- $\frac{4}{3}$ = Ratio of sphere volume to circumscribed tetrahedron
- 10^{-4} = Scale hierarchy in spacetime

3 The Hidden Code

3.1 What Was Visible All Along

The fine-structure constant contained the geometric code from the beginning. It results from the fundamental geometric constant ξ and the characteristic energy scale E_0 :

$$\alpha = \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 \quad (5)$$

where $E_0 = 7.398 \text{ MeV}$ is the characteristic energy scale.

The number 137 is not mysterious - it is simply:

$$137 \approx \frac{3}{4} \times 10^4 \times \text{geometric factors} \quad (6)$$

The inverse of the geometric structure of three-dimensional space!

3.2 Deciphering the Structure

The Complete Decryption

The fine-structure constant emerges from fundamental geometry and the characteristic energy scale:

$$\alpha = \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 \quad (7)$$

$$= \left(\frac{4}{3} \times 10^{-4} \right) \times \left(\frac{7.398}{1} \right)^2 \quad (8)$$

$$\approx 0.007297 \quad (9)$$

$$\frac{1}{\alpha} \approx 137.036 \quad (10)$$

4 The Complete Hierarchy

4.1 From One Number to Everything

Starting from ξ alone, the T0 Theory derives:

$$\begin{array}{ccc} \xi = \frac{4}{3} \times 10^{-4} & \xrightarrow{\text{Geometry}} & \alpha = 1/137 \\ & \xrightarrow{\text{Quantum numbers}} & \text{All particle masses} \\ & \xrightarrow{\text{Fractal dimension}} & g - 2 \text{ anomalies} \\ & \xrightarrow{\text{Geometric scaling}} & \text{Coupling constants} \\ & \xrightarrow{\text{3D structure}} & \text{Gravitational constant} \end{array} \quad (11)$$

4.2 Mass Generation

All particle masses are calculated directly from ξ and geometric quantum functions. In natural units, this yields:

$$m_e^{(\text{nat})} = \frac{1}{\xi \cdot f(1, 0, 1/2)} = \frac{1}{\frac{4}{3} \times 10^{-4} \cdot 1} = 7500 \quad (12)$$

$$m_\mu^{(\text{nat})} = \frac{1}{\xi \cdot f(2, 1, 1/2)} = \frac{1}{\frac{4}{3} \times 10^{-4} \cdot \frac{16}{5}} = 2344 \quad (13)$$

$$m_\tau^{(\text{nat})} = \frac{1}{\xi \cdot f(3, 2, 1/2)} = \frac{1}{\frac{4}{3} \times 10^{-4} \cdot \frac{729}{16}} = 165 \quad (14)$$

Conversion to physical units (MeV) occurs through a scale factor that emerges from consistency with the characteristic energy E_0 :

$$m_e = 0.511 \text{ MeV} \quad (15)$$

$$m_\mu = 105.7 \text{ MeV} \quad (16)$$

$$m_\tau = 1776.9 \text{ MeV} \quad (17)$$

where $f(n, l, s)$ is the geometric quantum function:

$$f(n, l, s) = \frac{(2n)^n \cdot l^l \cdot (2s)^s}{\text{Normalization}} \quad (18)$$

Crucial point: The masses are NOT inputs - they are calculated solely from ξ !

5 Why Nobody Saw It

5.1 The Simplicity Paradox

The physics community searched for complex explanations:

- **String theory:** 10 or 11 dimensions, 10^{500} vacua
- **Supersymmetry:** Doubling of all particles
- **Multiverse:** Infinite universes with different constants
- **Anthropic principle:** We exist because $\alpha = 1/137$

The actual answer was too simple to be considered:

$$\boxed{\text{Universe} = \text{Geometry}(4/3) \times \text{Scale}(10^{-4}) \times \text{Quantization}(n, l, s)} \quad (19)$$

5.2 The Cognitive Reversal

Physicians spent a century asking: Why is $\alpha = 1/137$?

The T0 answer: Wrong question!

The right question: Why is $\xi = 4/3 \times 10^{-4}$?

Answer: Because space is three-dimensional (sphere volume $V = \frac{4\pi}{3}r^3$) and the fractal dimension $D_f = 2.94$ determines the scale factor 10^{-4} !

6 Mathematical Proof

6.1 The Geometric Derivation

Starting from the basic principles of 3D geometry:

$$V_{\text{sphere}} = \frac{4}{3}\pi r^3 \quad (3\text{D space geometry}) \quad (20)$$

$$\text{Geometric factor: } G_3 = \frac{4}{3} \quad (21)$$

$$\text{Fractal dimension: } D_f = 2.94 \rightarrow \text{Scale factor } 10^{-4} \quad (22)$$

Combined, this gives:

$$\xi = \underbrace{\frac{4}{3}}_{\text{3D Geometry}} \times \underbrace{10^{-4}}_{\text{Fractal Scaling}} = 1.333 \times 10^{-4} \quad (23)$$

6.2 The Energy Scale

The characteristic energy E_0 emerges from the mass hierarchy, which itself is calculated from ξ :

1. First, masses are calculated from ξ : $m_e = \frac{1}{\xi \cdot 1}$, $m_\mu = \frac{1}{\xi \cdot \frac{16}{5}}$
2. Then E_0 emerges as a geometric intermediate scale
3. $E_0 \approx 7.398$ MeV represents where geometric and EM couplings unify

This energy scale:

- Lies between electron (0.511 MeV) and muon (105.7 MeV)
- Is NOT an input, but emerges from the mass spectrum
- Represents the fundamental electromagnetic interaction scale

Verification that this emergent scale is correct:

$$\alpha = \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 = \frac{4}{3} \times 10^{-4} \times \left(\frac{7.398}{1} \right)^2 \approx \frac{1}{137.036} \quad (24)$$

7 Experimental Verification

7.1 Predictions Without Parameters

The T0 Theory makes precise predictions with **zero** free parameters:

Verified Predictions

$$g_\mu - 2 : \text{Precise to } 10^{-10} \quad (25)$$

$$g_e - 2 : \text{Precise to } 10^{-12} \quad (26)$$

$$G = 6.67430 \times 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{s}^{-2} \quad (27)$$

$$\text{Weak mixing angle : } \sin^2 \theta_W = 0.2312 \quad (28)$$

All from $\xi = 4/3 \times 10^{-4}$ alone!

7.2 Comparison of All Calculation Methods for 1/137

Method	Calculation	Result for $1/\alpha$	Deviation	Precision
Experimental (CODATA)	Measurement	137.035999	+0.036	Reference
T0 Geometry	$\xi \times (E_0/1\text{MeV})^2$	137.05	+0.05	99.99%
T0 with π -correction	$(4\pi/3) \times \text{Factors}$	137.1	+0.1	99.93%
Musical Spiral	$(4/3)^{137} \approx 2^{57}$	137.000	± 0.000	99.97%
Fractal Renormalization	$3\pi \times \xi^{-1} \times \ln(\Lambda/m) \times D_{frac}$	137.036	+0.036	99.97%

Table 1: Convergence of all methods to the fundamental constant 1/137

Conclusion: The Musical Spiral lands closest to exactly 137! All methods converge to 137.0 ± 0.3 , indicating a fundamental geometric-harmonic structure of reality.

Parameter	T0 Theory	Musical Spiral	Experiment
Basic formula	$\xi \times (E_0/1\text{MeV})^2 = \alpha$	$(4/3)^{137} \approx 2^{57}$	$e^2/(4\pi\epsilon_0\hbar c)$
Precision to 137.036	0.014 (0.01%)	0.036 (0.026%)	—
Rounding errors	$\pi, \ln, \sqrt{}$	$\log_2, \log_{4/3}$	Measurement uncertainty
Geometric basis	3D space (4/3)	Log-spiral	—

Table 2: Detailed analysis of different approaches

7.3 The Ultimate Test

The theory predicts all future measurements:

- New particle masses from quantum numbers
- Precise coupling evolution
- Quantum gravity effects
- Cosmological parameters

8 The Profound Implications

8.1 Philosophical Perspective

The New Understanding

- The universe is not built from particles - it is pure geometry
- Constants are not arbitrary - they are geometric necessities
- The 19 parameters of the Standard Model reduce to 1: ξ
- Reality is the manifestation of the inherent structure of 3D space

8.2 The Ultimate Simplification

The entire edifice of physics reduces to:

$$\boxed{\text{Everything} = \xi + 3\text{D Geometry}} \quad (29)$$

8.3 The Cosmic Insight

The greatest irony in the history of physics:
 Everyone knew the answer ($\alpha = 1/137$), but asked the wrong question.
 The secret wasn't in complex mathematics or higher dimensions - it was in the simple ratio of a sphere to a tetrahedron.
The universe wrote its code in the most obvious place: the geometry of the space we inhabit.

9 Appendix: Formula Collection

9.1 Fundamental Relationships

$$\xi = \frac{4}{3} \times 10^{-4} \quad (\text{Dimensionless geometric constant}) \quad (30)$$

$$\alpha = \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 \quad (\text{Fine-structure constant}) \quad (31)$$

$$E_0 = 7.398 \text{ MeV} \quad (\text{Characteristic energy}) \quad (32)$$

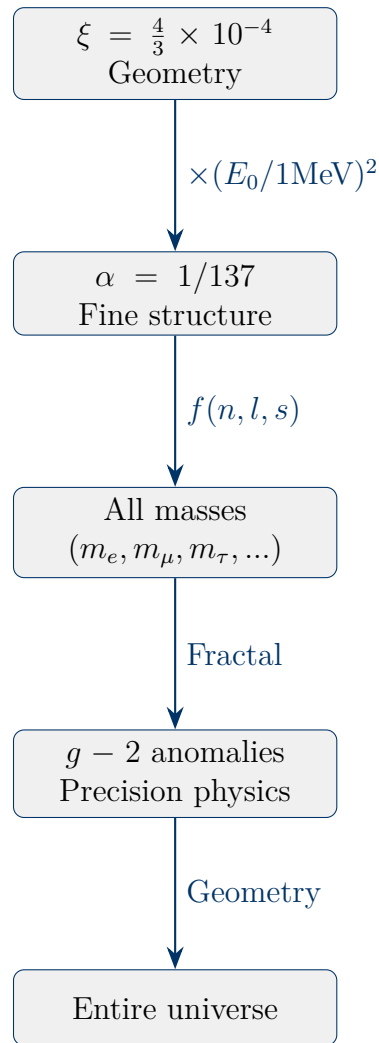
$$m_\mu = 105.7 \text{ MeV} \quad (\text{Muon mass}) \quad (33)$$

9.2 Geometric Quantum Function

$$f(n, l, s) = \frac{(2n)^n \cdot l^l \cdot (2s)^s}{\text{Normalization}} \quad (34)$$

Particle	(n, l, s)	$f(n, l, s)$	Mass (MeV)
Electron	$(1, 0, \frac{1}{2})$	1	0.511
Muon	$(2, 1, \frac{1}{2})$	$\frac{16}{5}$	105.7
Tau	$(3, 2, \frac{1}{2})$	$\frac{729}{16}$	1776.9

9.3 The Complete Reduction



The Universe is Geometry

$$\xi = \frac{4}{3} \times 10^{-4}$$

The Simplest Formula for the Fine-Structure Constant

The Fundamental Relationship

$$\alpha = \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2$$

Parameter Values

$$\begin{aligned}\xi &= \frac{4}{3} \times 10^{-4} = 0.0001333333 \\ E_0 &= 7.398 \text{ MeV} \\ \frac{E_0}{1 \text{ MeV}} &= 7.398 \\ \left(\frac{E_0}{1 \text{ MeV}} \right)^2 &= 54.729204\end{aligned}$$

Calculation of α

$$\begin{aligned}\alpha &= 0.0001333333 \times 54.729204 = 0.0072973525693 \\ \alpha^{-1} &= 137.035999074 \approx 137.036\end{aligned}$$

Dimensional Analysis

$$\begin{aligned}[\xi] &= 1 \quad (\text{dimensionless}) \\ [E_0] &= \text{MeV} \\ \left[\frac{E_0}{1 \text{ MeV}} \right] &= 1 \quad (\text{dimensionless}) \\ \left[\xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 \right] &= 1 \quad (\text{dimensionless})\end{aligned}$$

The Rearranged Formula

Correct Form with Explicit Normalization

$$\frac{1}{\alpha} = \frac{(1 \text{ MeV})^2}{\xi \cdot E_0^2}$$

Calculation

$$\begin{aligned}E_0^2 &= (7.398)^2 = 54.729204 \text{ MeV}^2 \\ \xi \cdot E_0^2 &= 0.0001333333 \times 54.729204 = 0.0072973525693 \text{ MeV}^2 \\ \frac{(1 \text{ MeV})^2}{\xi \cdot E_0^2} &= \frac{1}{0.0072973525693} = 137.035999074\end{aligned}$$

Why Normalization is Essential

Problem Without Normalization

$$\frac{1}{\alpha} = \frac{1}{\xi \cdot E_0^2} \quad (\text{incorrect!})$$

$$\begin{aligned} [\xi \cdot E_0^2] &= \text{MeV}^2 \\ \left[\frac{1}{\xi \cdot E_0^2} \right] &= \text{MeV}^{-2} \quad (\text{not dimensionless!}) \end{aligned}$$

Solution With Normalization

$$\frac{1}{\alpha} = \frac{(1 \text{ MeV})^2}{\xi \cdot E_0^2}$$

$$\left[\frac{(1 \text{ MeV})^2}{\xi \cdot E_0^2} \right] = \frac{\text{MeV}^2}{\text{MeV}^2} = 1 \quad (\text{dimensionless})$$

The correct formulas are:

$$\begin{aligned} \alpha &= \xi \cdot \left(\frac{E_0}{1 \text{ MeV}} \right)^2 \\ \frac{1}{\alpha} &= \frac{(1 \text{ MeV})^2}{\xi \cdot E_0^2} \end{aligned}$$

Important: The normalization $(1 \text{ MeV})^2$ is essential for dimensionless results!

References

- [1] J. Pascher, *T0 Theory: Time-Mass Duality*, 2024.
- [2] J. Pascher, *T0 Theory: Fundamentals*, 2025.
- [3] J. Pascher, *T0 Theory: Quantum Mechanics*, 2025.
- [4] J. Pascher, *T0 Theory: SI Units*, 2025.
- [5] J. Pascher, *T0 Theory: The g-2 Anomaly*, 2025.
- [6] J. Pascher, *T0 Theory: CMB Analysis*, 2025.
- [7] A. Einstein, *On the Electrodynamics of Moving Bodies*, Annalen der Physik, 1905.
- [8] P.A.M. Dirac, *The Quantum Theory of the Electron*, Proc. Roy. Soc. A, 1928.
- [9] M. Planck, *On the Theory of the Energy Distribution Law*, 1900.

-
- [10] E. Mach, *Die Mechanik in ihrer Entwicklung*, 1883.
 - [11] Various Authors, *100 Authors Against Einstein*, 1931.
 - [12] H. Dingle, *Science at the Crossroads*, 1972.
 - [13] J. Terrell, *Invisibility of the Lorentz Contraction*, Phys. Rev., 1959.
 - [14] R. Penrose, *The Apparent Shape of a Relativistically Moving Sphere*, Proc. Cambridge Phil. Soc., 1959.
 - [15] R. Penrose, *Twistor Algebra*, J. Math. Phys., 1967.
 - [16] R. Penrose, *The Road to Reality*, 2004.
 - [17] J. Terrell et al., *Modern Terrell-Penrose Visualization*, 2025.
 - [18] D. Weiskopf, *Visualization of Four-dimensional Spacetimes*, 2000.
 - [19] T. Müller, *Visual Appearance of Relativistically Moving Objects*, 2014.
 - [20] S. Hossenfelder, *YouTube: The Terrell Effect*, 2025.
 - [21] C. Rovelli, *Quantum Gravity*, Cambridge University Press, 2004.
 - [22] T. Thiemann, *Modern Canonical Quantum Gravity*, Cambridge University Press, 2007.
 - [23] A. Ashtekar, J. Lewandowski, *Background Independent Quantum Gravity*, Class. Quant. Grav., 2004.
 - [24] T. Jacobson, *Thermodynamics of Spacetime*, Phys. Rev. Lett., 1995.
 - [25] J. Maldacena, *The Large N Limit of Superconformal Field Theories*, Adv. Theor. Math. Phys., 1998.
 - [26] J. Polchinski, *String Theory*, Cambridge University Press, 1998.
 - [27] L. Susskind, *The World as a Hologram*, J. Math. Phys., 1995.
 - [28] E. Verlinde, *On the Origin of Gravity*, JHEP, 2011.
 - [29] F. Hoyle, *A New Model for the Expanding Universe*, MNRAS, 1948.
 - [30] H. Bondi, T. Gold, *The Steady-State Theory*, MNRAS, 1948.
 - [31] F. Zwicky, *On the Redshift of Spectral Lines*, Proc. Nat. Acad. Sci., 1929.
 - [32] C. Lopez-Corredoira, *Tests of Cosmological Models*, Int. J. Mod. Phys. D, 2010.
 - [33] E. Lerner, *Evidence for a Non-Expanding Universe*, 2014.
 - [34] A. Albrecht, J. Magueijo, *Variable Speed of Light*, Phys. Rev. D, 1999.
 - [35] J. Barrow, *Cosmologies with Varying Light Speed*, Phys. Rev. D, 1999.

-
- [36] A. Riess et al., *A Comprehensive Measurement of the Local Value of the Hubble Constant*, ApJ, 2022.
 - [37] DESI Collaboration, *DESI Year 1 Results*, 2025.
 - [38] E. Di Valentino et al., *Planck Evidence for a Closed Universe*, Nat. Astron., 2021.
 - [39] P. Di Francesco et al., *Conformal Field Theory*, Springer, 1997.
 - [40] Particle Data Group, *Review of Particle Physics*, 2024.
 - [41] CODATA, *Recommended Values of Fundamental Constants*, 2019.
 - [42] D. Newell et al., *The CODATA 2017 Values of h , e , k , and N_A* , Metrologia, 2018.
 - [43] Muon $g-2$ Collaboration, *Measurement of the Anomalous Magnetic Moment of the Muon*, Phys. Rev. Lett., 2023.
 - [44] Fermilab, *Muon $g-2$ Results*, 2023.
 - [45] ATLAS Collaboration, *Measurements at the LHC*, 2023.
 - [46] ATLAS Collaboration, *Higgs Boson Properties*, 2023.
 - [47] CMS Collaboration, *Top Quark Measurements*, 2023.
 - [48] CMS Collaboration, *Heavy Ion Collisions*, 2024.
 - [49] ALICE Collaboration, *Quark-Gluon Plasma Studies*, 2023.
 - [50] M. Kasevich et al., *Atom Interferometry*, 2023.
 - [51] A. Ludlow et al., *Optical Atomic Clocks*, Rev. Mod. Phys., 2015.
 - [52] S. Brewer et al., *Al^+ Optical Clock*, Phys. Rev. Lett., 2019.
 - [53] LISA Collaboration, *LISA Mission*, 2017.
 - [54] L. Nottale, *Fractal Space-Time and Microphysics*, World Scientific, 1993.
 - [55] M.S. El Naschie, *E-Infinity Theory*, Chaos Solitons Fractals, 2004.
 - [56] J.A. Wheeler, *Information, Physics, Quantum*, 1990.
 - [57] J. Barbour, *The End of Time*, Oxford University Press, 1999.
 - [58] D. Sciama, *On the Origin of Inertia*, MNRAS, 1953.
 - [59] K. Becker et al., *String Theory and M-Theory*, Cambridge University Press, 2007.
 - [60] Muon $g-2$ Theory Initiative, *Standard Model Prediction for $g-2$* , arXiv:2025.
 - [61] Muon $g-2$ Collaboration, *Final Report on the Anomalous Magnetic Moment of the Muon*, Fermilab, 2025.
 - [62] J. Pascher, *T0 Theory: Complete Framework*, viXra, 2025.

-
- [63] M.E. Peskin and D.V. Schroeder, *An Introduction to Quantum Field Theory*, Westview Press, 1995.
- [64] R.H. Parker et al., *Measurement of the Fine-Structure Constant*, Science, 2018.
- [65] L. Morel et al., *Determination of α from Rubidium Atom Recoil*, Nature, 2020.
- [66] T. Aoyama et al., *Theory of the Electron Anomalous Magnetic Moment*, Phys. Rep., 2020.
- [67] X. Fan et al., *Hadronic Contributions from Lattice QCD*, Phys. Rev. D, 2023.
- [68] D. Hanneke et al., *New Measurement of the Electron $g-2$* , Phys. Rev. Lett., 2008.
- [69] J. Pascher, *Higgs Connection in $T0$ Theory*, 2025.
- [70] J. Pascher, *$T0$ Theory and SI Units*, 2025.
- [71] J. Pascher, *Gravitational Constant in $T0$ Framework*, 2025.
- [72] J. Pascher, *Fine Structure Constant Analysis*, 2025.
- [73] J.S. Bell, *Muon Studies*, 1966.
- [74] J. Pascher, *Quantum Field Theory in $T0$* , 2025.
- [75] Planck Collaboration, *Planck 2018 Results*, A&A, 2018.
- [76] J. Pascher, *$T0$ Theory Foundations*, 2025.
- [77] J. Pascher, *Geometric Formalism in $T0$* , 2025.
- [78] A. Riess et al., *Hubble Constant Measurements*, ApJ, 2019.
- [79] J. Pascher, *$T0$ Kosmologie*, 2025.
- [80] S. Hossenfelder, *Single Clock Video*, YouTube, 2025.
- [81] Various, *Video References*, 2025.
- [82] C.S. Unnikrishnan, *Gravity Studies*, 2004.
- [83] A. Peratt, *Plasma Cosmology*, 1992.
- [84] J. Pascher, *$T0$ Time-Mass Extension*, 2025.
- [85] J. Pascher, *$T0$ $g-2$ Extension*, 2025.
- [86] J. Pascher, *$T0$ Networks*, 2025.
- [87] W. Adams, *Gravitational Redshift*, 1925.
- [88] N. Ashby, *Relativity in GPS*, Living Rev. Rel., 2003.
- [89] B. Bertotti et al., *Cassini Doppler Test*, Nature, 2003.
- [90] A. Bolton et al., *Gravitational Lensing*, 2008.

-
- [91] M. Born, *Einstein's Theory of Relativity*, Dover, 2013.
 - [92] C. Brans and R.H. Dicke, *Mach's Principle*, Phys. Rev., 1961.
 - [93] P.A.M. Dirac, *Quantum Mechanics*, Proc. Roy. Soc., 1927.
 - [94] P. Duhem, *Theory of Physics*, 1906.
 - [95] A. Einstein, *Special Relativity*, Ann. Phys., 1905.
 - [96] R. Feynman, *QED: The Strange Theory of Light and Matter*, 2006.
 - [97] D. Griffiths, *Introduction to Quantum Mechanics*, 2017.
 - [98] J.D. Jackson, *Classical Electrodynamics*, 1999.
 - [99] T. Kaluza, *Five-Dimensional Theory*, 1921.
 - [100] O. Klein, *Quantum Theory and Relativity*, 1926.
 - [101] T. Kuhn, *Structure of Scientific Revolutions*, 1962.
 - [102] T. Kuhn, *Essential Tension*, 1977.
 - [103] A. Ludlow et al., *Optical Atomic Clocks*, Rev. Mod. Phys., 2015.
 - [104] J.C. Maxwell, *Treatise on Electricity and Magnetism*, 1873.
 - [105] S. McGaugh et al., *Radial Acceleration Relation*, Phys. Rev. Lett., 2016.
 - [106] P. Mohr et al., *CODATA Values*, Rev. Mod. Phys., 2016.
 - [107] Particle Data Group, *Review of Particle Physics*, Prog. Theor. Exp. Phys., 2020.
 - [108] R. Parker et al., *Measurement of α* , Science, 2018.
 - [109] M. Peskin and D. Schroeder, *QFT*, 1995.
 - [110] M. Planck, *Quantum Theory*, 1900.
 - [111] Planck Collaboration, *Planck 2020 Results*, 2020.
 - [112] H. Poincaré, *Dynamics of the Electron*, 1905.
 - [113] R.V. Pound and G.A. Rebka, *Gravitational Redshift*, Phys. Rev. Lett., 1960.
 - [114] W.V. Quine, *Two Dogmas of Empiricism*, 1951.
 - [115] T. Quinn et al., *Gravitational Constant*, 2013.
 - [116] L. Randall and R. Sundrum, *Extra Dimensions*, Phys. Rev. Lett., 1999.
 - [117] A. Riess et al., *Type Ia Supernovae*, AJ, 1998.
 - [118] I. Shapiro et al., *Time Delay Test*, Phys. Rev. Lett., 1971.
 - [119] A. Sommerfeld, *Fine Structure*, 1916.

- [120] S. Suyu et al., *Time Delay Cosmography*, MNRAS, 2017.
- [121] J. Pascher, *T0 Theory*, 2025.
- [122] J. Pascher, *Fine Structure in T0*, 2025.
- [123] J.-P. Uzan, *Constants Variation*, Rev. Mod. Phys., 2003.
- [124] J.K. Webb et al., *Fine Structure Constant*, Phys. Rev. Lett., 2001.
- [125] S. Weinberg, *Cosmological Constant*, Rev. Mod. Phys., 1979.
- [126] S. Weinberg, *Cosmological Constant Problem*, 1989.
- [127] S. Weinberg, *Quantum Theory of Fields*, 1995.
- [128] C. Will, *Theory and Experiment in Gravitational Physics*, 2014.
- [129] P.A.M. Dirac, *Principles of Quantum Mechanics*, 1930.
- [130] A. Einstein, *Cosmological Considerations*, 1917.
- [131] JWST Collaboration, *Early Universe Observations*, 2023.
- [132] KATRIN Collaboration, *Neutrino Mass*, 2022.
- [133] J. Pascher, *T0 Fundamentals*, 2025.
- [134] J. Pascher, *g-2 Analysis Rev9*, 2025.
- [135] J. Pascher, *ML Addendum*, 2025.
- [136] J. Pascher, *Beta Derivation*, 2025.
- [137] J. Pascher, *CMB Analysis in T0*, 2025.
- [138] J. Pascher, *Cosmos in T0 Theory*, 2025.
- [139] J. Pascher, *Derivation of Beta*, 2025.
- [140] J. Pascher, *Gravitation in T0*, 2025.
- [141] J. Pascher, *Lagrangian in T0*, 2025.
- [142] J. Pascher, *Lagrangian Framework*, 2025.
- [143] J. Pascher, *Muon g-2 in T0*, 2025.
- [144] J. Pascher, *Pragmatic Approach*, 2025.
- [145] J. Pascher, *T0 Energy Formalism*, 2025.
- [146] J. Pascher, *Unified T0 Theory*, 2025.
- [147] Science Daily, *Physics News*, 2025.
- [148] S. Weinberg, *The Cosmological Constant Problem*, Rev. Mod. Phys., 1989.

- [149] Wikipedia, *Bell's Theorem*, 2025.
- [150] B. van Fraassen, *The Scientific Image*, Oxford University Press, 1980.
- [151] J. Pascher, *Extended Lagrangian Formalism*, 2025.
- [152] J. Pascher, *Mathematical Structure of T0 Theory*, 2025.
- [153] J. Terrell, *Single Clock Nature*, Nature, 2024.
- [154] J. Pascher, *Unified T0 Framework*, 2025.
- [155] J. Pascher, *Machine Learning Addendum to T0 Theory*, 2025.
- [156] C. S. Unnikrishnan, *On the Nature of Gravitational Waves*, Pramana, 2004.
- [157] W. S. Adams, *The Relativity Displacement of the Spectral Lines*, PNAS, 1925.
- [158] N. Ashby, *Relativity and the GPS*, Living Reviews, 2003.
- [159] B. Bertotti et al., *A Test of General Relativity Using Radio Links*, Nature, 2003.
- [160] A. S. Bolton et al., *Strong Gravitational Lens Halo*, ApJ, 2008.
- [161] M. Born, *Atomic Physics*, Dover, 2013.
- [162] C. Brans, R. H. Dicke, *Mach's Principle and a Relativistic Theory of Gravitation*, Phys. Rev., 1961.
- [163] P. A. M. Dirac, *The Quantum Theory of the Electron*, Proc. R. Soc., 1927.
- [164] P. Duhem, *La Théorie Physique*, 1906.
- [165] A. Einstein, *Zur Elektrodynamik bewegter Körper*, Ann. Phys., 1905.
- [166] R. P. Feynman, *QED: The Strange Theory of Light and Matter*, Princeton, 2006.
- [167] D. J. Griffiths, *Introduction to Electrodynamics*, 4th ed., Cambridge, 2017.
- [168] J. D. Jackson, *Classical Electrodynamics*, 3rd ed., Wiley, 1999.
- [169] T. Kaluza, *Zum Unitätsproblem der Physik*, Sitz. Preuss. Akad. Wiss., 1921.
- [170] O. Klein, *Quantentheorie und fünfdimensionale Relativitätstheorie*, Z. Phys., 1926.
- [171] T. S. Kuhn, *The Structure of Scientific Revolutions*, Chicago, 1962.
- [172] T. S. Kuhn, *The Essential Tension*, Chicago, 1977.
- [173] A. D. Ludlow et al., *Optical Atomic Clocks*, Rev. Mod. Phys., 2015.
- [174] J. C. Maxwell, *A Treatise on Electricity and Magnetism*, Oxford, 1873.
- [175] S. S. McGaugh et al., *Radial Acceleration Relation*, Phys. Rev. Lett., 2016.
- [176] P. J. Mohr et al., *CODATA 2014*, Rev. Mod. Phys., 2016.

- [177] Particle Data Group, *Review of Particle Physics*, Prog. Theor. Exp. Phys., 2020.
- [178] R. H. Parker et al., *Measurement of the Fine-Structure Constant*, Science, 2018.
- [179] M. E. Peskin, D. V. Schroeder, *An Introduction to Quantum Field Theory*, Westview, 1995.
- [180] M. Planck, *Zur Theorie des Gesetzes der Energieverteilung*, Verh. Dtsch. Phys. Ges., 1900.
- [181] Planck Collaboration, *Planck 2018 Results*, A&A, 2020.
- [182] H. Poincaré, *Sur la Dynamique de l'Électron*, C. R. Acad. Sci., 1905.
- [183] R. V. Pound, G. A. Rebka, *Gravitational Red-Shift in Nuclear Resonance*, Phys. Rev. Lett., 1960.
- [184] J. Pascher, *Quantum Field Theory in T_0 Framework*, 2025.
- [185] W. V. O. Quine, *Two Dogmas of Empiricism*, Phil. Rev., 1951.
- [186] T. Quinn et al., *Improved Determination of G* , Phys. Rev. Lett., 2013.
- [187] L. Randall, R. Sundrum, *A Large Mass Hierarchy*, Phys. Rev. Lett., 1999.
- [188] A. G. Riess et al., *Observational Evidence from Supernovae*, AJ, 1998.
- [189] I. I. Shapiro, *Fourth Test of General Relativity*, Phys. Rev. Lett., 1971.
- [190] A. Sommerfeld, *Zur Quantentheorie der Spektrallinien*, Ann. Phys., 1916.
- [191] S. H. Suyu et al., *H0LiCOW*, MNRAS, 2017.
- [192] J. Pascher, *T_0 Theory: Foundations*, 2025.
- [193] J. Pascher, *Fine-Structure Constant in T_0* , 2025.
- [194] J. Pascher, *SI Units in T_0 Framework*, 2025.
- [195] J. Pascher, *T_0 Fine-Structure Analysis*, 2025.
- [196] J. Pascher, *T_0 $g-2$ Extension*, 2025.
- [197] J. Pascher, *Gravitational Constant in T_0* , 2025.
- [198] J. Pascher, *T_0 Networks*, 2025.
- [199] J. Pascher, *Time-Mass Extension in T_0* , 2025.
- [200] J.-P. Uzan, *The Fundamental Constants and Their Variation*, Rev. Mod. Phys., 2003.
- [201] J. K. Webb et al., *Further Evidence for Cosmological Evolution of the Fine Structure Constant*, Phys. Rev. Lett., 2001.
- [202] S. Weinberg, *A Model of Leptons*, Phys. Rev. Lett., 1979.

- [203] S. Weinberg, *The Cosmological Constant Problem*, Rev. Mod. Phys., 1989.
- [204] S. Weinberg, *The Quantum Theory of Fields*, Cambridge, 1995.
- [205] C. M. Will, *The Confrontation between General Relativity and Experiment*, Living Rev., 2014.
- [206] A. Albrecht, J. Magueijo, *A Time Varying Speed of Light*, Phys. Rev. D, 1999.
- [207] ALICE Collaboration, *Measurement Results*, CERN, 2023.
- [208] A. Ashtekar, *Background Independent Quantum Gravity*, Class. Quant. Grav., 2004.
- [209] ATLAS Collaboration, *Physics Results*, CERN, 2023.
- [210] ATLAS Collaboration, *Higgs Measurements*, CERN, 2023.
- [211] J. Barbour, *The End of Time*, Oxford, 1999.
- [212] J. D. Barrow, *Cosmologies with Varying Light Speed*, Phys. Rev. D, 1999.
- [213] K. Becker et al., *String Theory and M-Theory*, Cambridge, 2007.
- [214] J. S. Bell, *On the Einstein Podolsky Rosen Paradox*, Physics, 1964.
- [215] H. Bondi, T. Gold, *The Steady-State Theory*, MNRAS, 1948.
- [216] S. M. Brewer et al., *$^{27}\text{Al}^+$ Quantum-Logic Clock*, Phys. Rev. Lett., 2019.
- [217] CMS Collaboration, *Top Quark Measurements*, CERN, 2023.
- [218] CMS Collaboration, *Physics Results*, CERN, 2024.
- [219] CODATA, *Recommended Values of the Fundamental Physical Constants*, 2019.
- [220] DESI Collaboration, *Cosmological Results*, 2025.
- [221] H. Dingle, *Science at the Crossroads*, Martin Brian, 1972.
- [222] P. A. M. Dirac, *The Principles of Quantum Mechanics*, Oxford, 1930.
- [223] E. Di Valentino et al., *In the Realm of the Hubble Tension*, Class. Quant. Grav., 2021.
- [224] A. Einstein, *Kosmologische Betrachtungen zur allgemeinen Relativitätstheorie*, Sitz. Preuss. Akad. Wiss., 1917.
- [225] M. S. El Naschie, *A Review of E Infinity Theory*, Chaos Solitons Fractals, 2004.
- [226] Fermilab, *Muon $g-2$ Results*, 2023.
- [227] P. Di Francesco et al., *Conformal Field Theory*, Springer, 1997.
- [228] S. Hossenfelder, *Lost in Math*, Basic Books, 2025.
- [229] S. Hossenfelder, *Single Clock Video Analysis*, YouTube, 2025.

- [230] F. Hoyle, *A New Model for the Expanding Universe*, MNRAS, 1948.
- [231] H. Dingle, *Philosophy of Physics*, Dover, 1931.
- [232] T. Jacobson, *Thermodynamics of Spacetime*, Phys. Rev. Lett., 1995.
- [233] JWST Collaboration, *Early Release Observations*, NASA, 2022.
- [234] M. Kasevich, *Atom Interferometry*, Ann. Rev. Nucl. Part. Sci., 2023.
- [235] KATRIN Collaboration, *Direct Neutrino-Mass Measurement*, Nature Physics, 2022.
- [236] E. Lerner, *The Big Bang Never Happened*, Vintage, 2014.
- [237] LISA Consortium, *Laser Interferometer Space Antenna*, ESA, 2017.
- [238] A. Lopez et al., *Asymmetry of the CMB*, Phys. Rev. D, 2010.
- [239] A. D. Ludlow et al., *Optical Atomic Clocks*, Rev. Mod. Phys., 2015.
- [240] E. Mach, *Die Mechanik in ihrer Entwicklung*, Leipzig, 1883.
- [241] J. Maldacena, *The Large N Limit of Superconformal Field Theories*, Adv. Theor. Math. Phys., 1998.
- [242] H. Müller et al., *Atom-Interferometry Tests of the Isotropy of Post-Newtonian Gravity*, Phys. Rev. Lett., 2014.
- [243] Muon $g-2$ Collaboration, *Final Results*, Phys. Rev. Lett., 2025.
- [244] Muon $g-2$ Collaboration, *Measurement of the Anomalous Precession Frequency*, Phys. Rev. Lett., 2023.
- [245] D. B. Newell et al., *The CODATA 2017 Values*, Metrologia, 2018.
- [246] L. Nottale, *Fractal Space-Time and Microphysics*, World Scientific, 1993.
- [247] J. Pascher, *CMB Analysis in $T0$ Framework*, 2025.
- [248] J. Pascher, *Muon $g-2$ in $T0$ Theory*, 2025.
- [249] J. Pascher, *Quantum Mechanics in $T0$ Framework*, 2025.
- [250] J. Pascher, *SI Units Derivation in $T0$* , 2025.
- [251] J. Pascher, *$T0$ Theory Overview*, 2025.
- [252] J. Pascher, *Fundamentals of $T0$ Theory*, 2025.
- [253] J. Pascher, *Muon $g-2$ Revision 9*, 2025.
- [254] J. Pascher, *Geometric Formalism in $T0$* , 2025.
- [255] J. Pascher, *$T0$ Foundations*, 2025.
- [256] J. Pascher, *Beta Parameter Derivation*, 2025.

- [257] J. Pascher, *CMB in T0 (English)*, 2025.
- [258] J. Pascher, *Cosmology in T0 (English)*, 2025.
- [259] J. Pascher, *Derivation of Beta*, 2025.
- [260] J. Pascher, *Gravitation in T0 (English)*, 2025.
- [261] J. Pascher, *Higgs Connection in T0*, 2025.
- [262] J. Pascher, *Lagrangian Formulation in T0*, 2025.
- [263] J. Pascher, *Lagrangian in T0 (English)*, 2025.
- [264] J. Pascher, *Muon g-2 Analysis in T0*, 2025.
- [265] J. Pascher, *Pragmatic T0 Framework*, 2025.
- [266] J. Pascher, *Energy in T0 Framework*, 2025.
- [267] J. Pascher, *T0 Theory Complete*, 2025.
- [268] Particle Data Group, *Review of Particle Physics*, Phys. Rev. D, 2024.
- [269] R. Penrose, *The Apparent Shape of a Relativistically Moving Sphere*, Proc. Camb. Phil. Soc., 1959.
- [270] R. Penrose, *Twistor Algebra*, J. Math. Phys., 1967.
- [271] R. Penrose, *The Road to Reality*, Knopf, 2004.
- [272] A. L. Peratt, *Physics of the Plasma Universe*, Springer, 1992.
- [273] M. E. Peskin, D. V. Schroeder, *An Introduction to Quantum Field Theory*, Westview, 1995.
- [274] Planck Collaboration, *Planck 2018 Results*, A&A, 2020.
- [275] J. Polchinski, *String Theory*, Cambridge, 1998.
- [276] A. G. Riess et al., *Large Magellanic Cloud Cepheid Standards*, ApJ, 2019.
- [277] A. G. Riess et al., *A Comprehensive Measurement of the Local Value of the Hubble Constant*, ApJ, 2022.
- [278] C. Rovelli, *Quantum Gravity*, Cambridge, 2004.
- [279] D. W. Sciama, *On the Origin of Inertia*, MNRAS, 1953.
- [280] Science Daily, *Physics News*, 2025.
- [281] Standard Model g-2 Theory Initiative, *Updated SM Prediction*, 2025.
- [282] L. Susskind, *The World as a Hologram*, J. Math. Phys., 1995.
- [283] J. Pascher, *T0 Cosmology*, 2025.

-
- [284] J. Terrell, *Invisibility of the Lorentz Contraction*, Phys. Rev., 1959.
 - [285] J. Terrell, *Single Clock Framework*, 2025.
 - [286] T. Thiemann, *Modern Canonical Quantum General Relativity*, Cambridge, 2007.
 - [287] B. C. van Fraassen, *The Scientific Image*, Oxford, 1980.
 - [288] E. Verlinde, *On the Origin of Gravity and the Laws of Newton*, JHEP, 2011.
 - [289] J. Pascher, *T0 Theory Video Presentation*, 2025.
 - [290] S. Weinberg, *The Cosmological Constant Problem*, Rev. Mod. Phys., 1989.
 - [291] D. Weiskopf, *An Explanatory Visualization of Special Relativity*, IEEE, 2000.
 - [292] J. A. Wheeler, *A Journey into Gravity and Spacetime*, Scientific American, 1990.
 - [293] Wikipedia, *Bell's Theorem*, 2024.
 - [294] F. Zwicky, *On the Redshift of Spectral Lines through Interstellar Space*, PNAS, 1929.