E=mc² Revisited

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E=mc² = E=m: The Constants Illusion Exposed

Why Einstein's c-constant conceals the fundamental error

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Abstract

This work reveals the central point of Einstein's relativity theory: E=mc² is mathematically identical to E=m. The only difference lies in Einstein's treatment of c as a "constant" instead of a dynamic ratio. By fixing c = 299,792,458 m/s, the natural time-mass duality $T \cdot m = 1$ is artificially "frozen," leading to apparent complexity. The T0 theory shows: c is not a fundamental law of nature, but only a ratio that must be variable if time is variable. Einstein's error was not E=mc² itself, but the constant-setting of c.

1   The Central Thesis: E=mc² = E=m

1.1   The Mathematical Identity

In natural units:

$$E = mc^2 = m \times c^2 = m \times 1^2 = m \tag{1}$$

This is not an approximation - this is exactly the same equation!

1.2   What is c really?

$$c = \frac{\text{Length}}{\text{Time}} = \frac{L}{T} \tag{2}$$

c is a ratio, not a natural constant!

2   Einstein's Fundamental Error: The Constant-Setting

2.1   The Act of Constant-Setting

Einstein set: $c = 299,792,458$ m/s = **constant**
   What does this mean?

$$c = \frac{L}{T} = \text{constant} \quad \Rightarrow \quad \frac{L}{T} = \text{fixed} \tag{3}$$

Implication: If L and T can vary, their **ratio** must remain constant.

2.2   The Problem of Time Variability

Einstein recognized himself: Time dilates!

$$t' = \gamma t \quad \text{(time is variable)} \tag{4}$$

But simultaneously he claimed:

$$c = \frac{L}{T} = \text{constant} \tag{5}$$

This is a logical contradiction!

2.3   The T0 Resolution

T0 insight: $\cdot m = 1$
    This means:

- Time **must** be variable (coupled to mass)

- Therefore $c = L/T$ **cannot** be constant

- c is a **dynamic ratio**, not a constant

3   The Constants Illusion: How it Works

3.1   The Mechanism of the Illusion

Step 1: Einstein sets c = constant

$$c = 299,792,458 \text{ m/s} = \text{fixed} \tag{6}$$

Step 2: Time becomes "frozen" by this

$$T = \frac{L}{c} = \frac{L}{\text{constant}} = \text{apparently determined} \tag{7}$$

Step 3: Time dilation becomes "mysterious effect"

$$t' = \gamma t \quad (\text{why?} \rightarrow \text{complicated relativity theory}) \tag{8}$$

3.2   What Really Happens (T0 View)

Reality: Time is naturally variable through $\cdot m = 1$
    Einstein's constant-setting "freezes" this natural variability artificially
    Result: One needs complicated theory to repair the "frozen" dynamics

4   c as Ratio vs. c as Constant

4.1   c as Natural Ratio (T0)

$$c(x,t) = \frac{L(x,t)}{T(x,t)} \tag{9}$$

Properties:

- c varies with location and time

- c follows the time-mass duality

- No artificial constants

- Natural simplicity: $E = m$

4.2   c as Artificial Constant (Einstein)

$$c = 299,792,458 \text{ m/s} = \text{constant everywhere} \tag{10}$$

Problems:

- Contradiction to time dilation

- Artificial "freezing" of time dynamics

- Complicated repair mathematics needed

- Inflated formula: $E = mc^2$

5   The Time Dilation Paradox

5.1   Einstein's Contradiction Exposed

Einstein claims simultaneously:

$$c = \text{constant} \tag{11}$$
$$t' = \gamma t \quad \text{(time varies)} \tag{12}$$

But:
$$c = \frac{L}{T} \quad \text{and} \quad T \text{ varies} \quad \Rightarrow \quad c \text{ cannot be constant!} \tag{13}$$

5.2   Einstein's Hidden Solution

Einstein "solves" the contradiction through:

- Complicated Lorentz transformations

- Mathematical formalisms

- Space-time constructions

- **But the logical contradiction remains!**

5.3   T0's Natural Solution

No contradiction in T0:

$$\cdot m = 1 \quad \Rightarrow \quad \text{time is naturally variable} \tag{14}$$

$$c = \frac{L}{T} \quad \Rightarrow \quad \text{c is naturally variable} \tag{15}$$

No constant-setting → No contradictions → No complicated repair mathematics

6   The Mathematical Demonstration

6.1   From E=mc² to E=m

Starting equation: $E = mc^2$
  c in natural units: $c = 1$
  Substitution:

$$E = mc^2 = m \times 1^2 = m \tag{16}$$

  Result: $E = m$

6.2   The Reverse Direction: From E=m to E=mc²

Starting equation: $E = m$
  Artificial constant introduction: $c = 299,792,458$ m/s
  Inflating the equation:

$$E = m = m \times 1 = m \times \frac{c^2}{c^2} = m \times c^2 \times \frac{1}{c^2} \tag{17}$$

  If one defines c^2 as "conversion factor":

$$E = mc^2 \tag{18}$$

  This shows: $E = mc^2$ is only $E = m$ with **artificial inflation factor** c^2!

7   The Arbitrariness of Constant Choice: c or Time?

7.1   Einstein's Arbitrary Decision

> **The Fundamental Choice Option**
>
> **One can choose what should be "constant"!**
> **Option 1 (Einstein's choice)**: c = constant → time becomes variable
> **Option 2 (alternative)**: time = constant → c becomes variable
> **Both describe the same physics!**

7.2   Option 1: Einstein's c-constant

Einstein chose:

$$c = 299,792,458 \text{ m/s} = \text{constant (defined)} \tag{19}$$
$$t' = \gamma t \quad \text{(time becomes automatically variable)} \tag{20}$$

  Language convention:

- "Speed of light is universally constant"

- "Time dilates in strong gravitational fields"

- "Clocks run slower at high velocities"

7.3   Option 2: Time-constant (Einstein could have chosen)

Alternative choice:

$$t = \text{constant (defined)} \tag{21}$$

$$c(x,t) = \frac{L(x,t)}{t} = \text{variable} \tag{22}$$

Alternative language convention:

- "Time flows equally everywhere"

- "Speed of light varies with location"

- "Light becomes slower in strong gravitational fields"

7.4   Mathematical Equivalence of Both Options

Both descriptions are mathematically identical:

Phenomenon	Einstein view	Time-constant view
Gravitation	Time slows down	Light slows down
Velocity	Time dilation	c-variation
GPS correction	"Clocks run differently"	"c is different"
Measurements	Same numbers	Same numbers

Table 1: Two views, identical physics

7.5   Why Einstein Chose Option 1

Historical reasons for Einstein's decision:

- **Michelson-Morley**: c seemed locally constant

- **Aesthetics**: "Universal constant" sounded elegant

- **Tradition**: Newtonian constant physics

- **Conceivability**: c-constancy easier to imagine than time constancy

- **Authority effect**: Einstein's prestige fixed this choice

But it was only a convention, not a natural law!

7.6   T0's Overcoming of Both Options

T0 shows: Both choices are arbitrary!

$$\cdot m = 1 \quad \text{(natural duality without constant constraint)} \tag{23}$$

T0 insight:

- **Neither** c nor time are "really" constant
- **Both** are aspects of the same $T \cdot m$ dynamics
- **Constancy** is only definition convention
- **E = m** is the constant-free truth

7.7   Liberation from Constant Constraint

Instead of choosing between:

- c constant, time variable (Einstein)
- Time constant, c variable (alternative)

T0 chooses:

- **Both dynamically coupled** via $T \cdot m = 1$
- **No arbitrary fixations**
- **Natural ratios** instead of artificial constants

8   The Reference Point Revolution: Earth → Sun → Nature

8.1   The Reference Point Analogy: Geocentric → Heliocentric → T0

> **The Reference Point Revolution: From Earth → Sun → Nature**
>
> **Geocentric (Ptolemy)**: Earth at center
> - Complicated epicycles needed
> - Works, but artificially complicated
>
> **Heliocentric (Copernicus)**: Sun at center
> - Simple ellipses
> - Much more elegant and simple
>
> **T0-centric**: Natural ratios at center
> - $\cdot m = 1$ (natural reference point)
> - Even more elegant: $E = m$

Einstein's c-constant corresponds to the geocentric system:

- **Human** reference point at center (like Earth at center)

- **Complicated** mathematics needed (like epicycles)

- **Works** locally, but artificially inflated

T0's natural ratios correspond to the heliocentric system:

- **Natural** reference point at center (like Sun at center)

- **Simple** mathematics (like ellipses)

- **Universally** valid and elegant

8.2   Why We Need Reference Points

Reference points are necessary and natural:

- **For measurements**: We need standards for comparison

- **For communication**: Common basis for exchange

- **For technology**: Practical applications require units

- **For science**: Reproducible experiments need standards

The question is not WHETHER, but WHICH reference point:

System	Reference Point	Complexity	Elegance
Geocentric	Earth	Epicycles	Low
Heliocentric	Sun	Ellipses	High
Einstein	c-constant	Relativity theory	Medium
T0	$\cdot m = 1$	$E = m$	Maximum

Table 2: Reference point systems comparison

8.3   The Right vs. Wrong Reference Point

Einstein's error was not to choose a reference point:

- **But to choose the wrong reference point!**

Wrong reference point (Einstein): c = 299,792,458 m/s = constant

- Based on human definition

- Leads to complicated mathematics

- Creates logical contradictions

Right reference point (T0): $\cdot m = 1$

- Based on natural ratio

- Leads to simple mathematics: $E = m$

- No contradictions, pure elegance

9   When Something Becomes "Constant"

9.1   The Fundamental Reference Point Problem

> **The Reference Point Illusion**
>
> **Something only becomes "constant" when we define a reference point!**
> **Without reference point**: All ratios are relative and dynamic
> **With reference point**: One ratio becomes artificially "fixed"
> **Einstein's error**: He defined an absolute reference point for c

9.2   The Natural Stage: Everything is Relative

Before any reference point definition:

$$c_1 = \frac{L_1}{T_1} \tag{24}$$

$$c_2 = \frac{L_2}{T_2} \tag{25}$$

$$c_3 = \frac{L_3}{T_3} \tag{26}$$

$$\vdots \tag{27}$$

All c-values are relative to each other. None is "constant".

9.3   The Moment of Reference Point Setting

Einstein's fatal step:

$$\text{"I define: } c = 299,792,458 \text{ m/s} = \text{reference point"} \tag{28}$$

What happens at this moment:

- An **arbitrary reference point** is set

- All other c-values are measured relative to this

- The **dynamic ratio** becomes a "constant"

- The **natural relativity** is artificially "frozen"

9.4   The Reference Point Problematic

Every reference point is arbitrary:

- Why 299,792,458 m/s and not 300,000,000 m/s?

- Why in m/s and not in other units?

- Why measured on Earth and not in space?

- Why at this time and not at another?

9.5   T0's Reference Point-Free Physics

T0 eliminates all reference points:

$$\cdot m = 1 \quad \text{(universal relation without reference point)} \tag{29}$$

- No arbitrary fixations

- All ratios remain dynamic

- Natural relativity is preserved

- Fundamental simplicity: $E = m$

9.6   Example: The Meter Definition

Historical development of meter definition:

1. **1793**: 1 meter = 1/10,000,000 of Earth meridian (Earth reference point)

2. **1889**: 1 meter = prototype meter in Paris (object reference point)

3. **1960**: 1 meter = 1,650,763.73 wavelengths of krypton-86 (atom reference point)

4. **1983**: 1 meter = distance light travels in 1/299,792,458 s (c reference point)

   What does this show?

- Each definition is **human arbitrariness**

- The **reference point** changes with human technology

- There is **no "natural" length unit** - only human agreements

- **Humans make c "constant" by definition** - not nature!

9.7   The Circular Error: Humans Define Their Own "Constants"

In 1983 humans defined:

$$1 \text{ meter} = \frac{1}{299,792,458} \times c \times 1 \text{ second} \tag{30}$$

This makes c automatically "constant" - through human definition, not through natural law:

$$c = \frac{299,792,458 \text{ meters}}{1 \text{ second}} = 299,792,458 \text{ m/s} \tag{31}$$

Circular reasoning: Humans define c as constant and then "measure" a constant!
Nature is not asked in this process!

9.8   T0's Resolution of the Reference Point Illusion

T0 recognizes:

- **Definition $\neq$ natural law**

- **Measurement reference point $\neq$ physical constant**

- **Practical agreement $\neq$ fundamental truth**

T0 solution:

$$\text{For measurements:} \quad \text{Use practical reference points} \tag{32}$$
$$\text{For natural laws:} \quad \text{Use reference point-free relations} \tag{33}$$

10   Why c-Constancy is Not Provable

10.1   The Fundamental Measurement Problem

To measure c, we need:
$$c = \frac{L}{T} \tag{34}$$

But: We measure L and T with **the same physical processes** that depend on c!
Circular problem:

- Light measures distances $\rightarrow$ c determines L

- Atomic clocks use EM transitions $\rightarrow$ c influences T

- Then we measure c = L/T $\rightarrow$ **We measure c with c!**

10.2   The Gauge Definition Problem

Since 1983: 1 meter = distance light travels in 1/299,792,458 s

$$c = 299,792,458 \text{ m/s} \quad \text{(not measured, but defined!)} \tag{35}$$

One cannot "prove" what one has defined!

10.3   The Systematic Compensation Problem

If c varies, ALL measuring devices vary equally:

- **Laser interferometers**: use light (c-dependent)

- **Atomic clocks**: use EM transitions (c-dependent)

- **Electronics**: uses EM signals (c-dependent)

Result: All devices **automatically compensate** the c-variation!

10.4   The Burden of Proof Problem

Scientifically correct:

- One **cannot prove** that something is constant

- One can only show that it **appears constant within measurement precision**

- **Each new precision level** could show variation

  Einstein's "c-constancy" was belief, not proof!

10.5   T0 Prediction for Precise Measurements

T0 predicts: At highest precision one will find:

$$c(x,t) = c_0 \left(1 + \xi \times \frac{(x,t) - _0}{_0} \right) \tag{36}$$

with $\xi = 1.33 \times 10^{-4}$ (T0 parameter)
c varies tiny ($\sim 10^{-15}$), but measurable in principle!

11   Ontological Consideration: Calculations as Constructs

11.1   The Fundamental Epistemological Limit

> **Ontological Truth**
>
> **All calculations are human constructs!**
> They can **at best** give a certain idea of reality.
> **That calculations are internally consistent proves little** about actual reality.
> **Mathematical consistency $\neq$ ontological truth**

11.2   Einstein's Construct vs. T0's Construct

Both are human thought structures:
  Einstein's construct:

- E = mc^2 (mathematically consistent)

- Relativity theory (internally coherent)

- 10 field equations (work computationally)

- **But**: Based on arbitrary c-constant setting

  T0's construct:

- E = m (mathematically simpler)

- $T \cdot m = 1$ (internally coherent)

- $\partial^2 E = 0$ (works computationally)

- **But**: Also only a human thought model

11.3   The Ontological Relativity

What is "really" real?

- **Einstein's space-time**? (construct)

- **T0's energy field**? (construct)

- **Newton's absolute time**? (construct)

- **Quantum mechanics' probabilities**? (construct)

All are human interpretive frameworks of the inaccessible reality!

11.4   Why T0 is Still "Better"

Not because of "absolute truth," but because of:
   1. Simplicity (Occam's Razor):

- $E = m$ is simpler than $E = mc^2$

- One equation is simpler than 10 equations

- Fewer arbitrary assumptions

   2. Consistency:

- No logical contradictions (like Einstein's)

- No constant arbitrariness

- Unified thought structure

   3. Predictive power:

- Testable predictions

- Fewer free parameters

- Clearer experimental distinction

   4. Aesthetics:

- Mathematical elegance

- Conceptual clarity

- Unity

11.5   The Epistemological Humility

T0 does NOT claim to be "absolute truth."
   T0 only says:

- "Here is a **simpler** construct"

- "With **fewer** arbitrary assumptions"

- "That is **more consistent** than Einstein's construct"

- "And makes **more testable** predictions"

But ultimately T0 also remains a human thought structure!

11.6   The Pragmatic Consequence

Since all theories are constructs:
   Evaluation criteria are:

1. **Simplicity** (fewer assumptions)

2. **Consistency** (no contradictions)

3. **Predictive power** (testable consequences)

4. **Elegance** (aesthetic criteria)

5. **Unity** (fewer separate domains)

   By all these criteria T0 is "better" than Einstein - but not "absolutely true".

11.7   The Ontological Humility

The deepest insight:

- **Reality itself** is inaccessible

- **All theories** are human constructs

- **Mathematical consistency** proves no ontological truth

- **The best** we have: **Simpler, more consistent constructs**

   Einstein's error was not only the c-constant setting, but also the claim to absolute truth of his mathematical constructs.
   T0's advantage is not absolute truth, but relative superiority as a thought model.

12   The Practical Consequences

12.1   Why E=mc² "Works"

E=mc² works because:

- It is mathematically identical to $E = m$

- c^2 compensates the "frozen" time dynamics

- The T0 truth is unconsciously contained

- Local approximations usually suffice

12.2 When E=mc² Fails

The constants illusion breaks down at:

- Very precise measurements

- Extreme conditions (high energies/masses)

- Cosmological scales

- Quantum gravity

12.3 T0's Universal Validity

E = m is valid everywhere and always:

- No approximations needed

- No constant assumptions

- Universal applicability

- Fundamental simplicity

13 The Correction of Physics History

13.1 Einstein's True Achievement

Einstein's actual discovery was:

$$E = m \quad \text{(in natural form)} \tag{37}$$

His error was:

$$E = mc^2 \quad \text{(with artificial constant inflation)} \tag{38}$$

13.2 The Historical Irony

> **The Great Irony**
>
> Einstein discovered the fundamental simplicity $E = m$,
> but **hid it behind the constants illusion $E = mc^2$**!
> The physics world celebrated the complicated form and overlooked the simple truth.

14 The T0 Perspective: c as Living Ratio

14.1 c as Expression of Time-Mass Duality

In T0 theory:

$$c(x,t) = f\left(\frac{L(x,t)}{(x,t)}\right) = f\left(\frac{L(x,t) \cdot m(x,t)}{1}\right) \tag{39}$$

since $\cdot m = 1$.
c becomes an expression of the fundamental time-mass duality!

14.2   The Dynamic Speed of Light

T0 prediction:

$$c(x,t) = c_0\sqrt{1 + \xi\frac{m(x,t) - m_0}{m_0}} \tag{40}$$

Light moves faster in more massive regions!
(Tiny effect, but measurable in principle)

15   Experimental Tests of c-Variability

15.1   Proposed Experiments

Test 1 - Gravitational dependence:

- Measure c in different gravitational fields

- T0 prediction: c varies with $\sim \xi \times \Delta\Phi_{\text{grav}}$

  Test 2 - Cosmological variation:

- Measure c over cosmological time periods

- T0 prediction: c changes with universe expansion

  Test 3 - High-energy physics:

- Measure c in particle accelerators at highest energies

- T0 prediction: Tiny deviations at $E \sim$ TeV

15.2   Expected Results

Experiment	Einstein (c constant)	T0 (c variable)
Gravitational field	$c = 299792458$ m/s	$c(1 \pm 10^{-15})$
Cosmological time	$c = $ constant	$c(1 + 10^{-12} \times t)$
High energy	$c = $ constant	$c(1 + 10^{-16})$

Table 3: Predicted c-variations

16   Conclusions

16.1   The Central Recognition

> **The Fundamental Truth**
>
> **E=mc² = E=m**
> Einstein's "constant" c is in truth a variable ratio.
> The constant-setting was Einstein's fundamental error.
> T0 corrects this error by returning to natural variability.

16.2 Physics After the Constants Illusion

The future of physics:

- No artificial constants

- Dynamic ratios everywhere

- Living, variable natural laws

- Fundamental simplicity: $E = m$

16.3 Einstein's Corrected Legacy

Einstein's true discovery: $E = m$ (energy-mass identity)
   Einstein's error: Constant-setting of c
   T0's correction: Return to natural form $E = m$
   Einstein was brilliant - he just stopped one step too early!

References

[1] J. Pascher, *T0 Theory: Time-Mass Duality*, 2024. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_unified_report.pdf

[2] J. Pascher, *T0 Theory: Fundamentals*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Grundlagen_En.pdf

[3] J. Pascher, *T0 Theory: Quantum Mechanics*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/QM_En.pdf

[4] J. Pascher, *T0 Theory: SI Units*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_SI_En.pdf

[5] J. Pascher, *T0 Theory: The g-2 Anomaly*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Anomale-g2-9_En.pdf

[6] J. Pascher, *T0 Theory: CMB Analysis*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Zwei-Dipole-CMB_En.pdf

[7] A. Einstein, *On the Electrodynamics of Moving Bodies*, Annalen der Physik, 1905. https://doi.org/10.1002/andp.19053221004

[8] P.A.M. Dirac, *The Quantum Theory of the Electron*, Proc. Roy. Soc. A, 1928. https://doi.org/10.1098/rspa.1928.0023

[9] M. Planck, *On the Theory of the Energy Distribution Law*, 1900. https://doi.org/10.1002/andp.19013090310

[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. https://doi.org/10.1103/PhysRev.116.1041

[14] R. Penrose, *The Apparent Shape of a Relativistically Moving Sphere*, Proc. Cambridge Phil. Soc., 1959. https://doi.org/10.1017/S0305004100033776

[15] R. Penrose, *Twistor Algebra*, J. Math. Phys., 1967. https://doi.org/10.1063/1.1705200

[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. https://doi.org/10.1088/0264-9381/21/15/R01

[24] T. Jacobson, *Thermodynamics of Spacetime*, Phys. Rev. Lett., 1995. https://doi.org/10.1103/PhysRevLett.75.1260

[25] J. Maldacena, *The Large N Limit of Superconformal Field Theories*, Adv. Theor. Math. Phys., 1998. https://doi.org/10.4310/ATMP.1998.v2.n2.a1

[26] J. Polchinski, *String Theory*, Cambridge University Press, 1998.

[27] L. Susskind, *The World as a Hologram*, J. Math. Phys., 1995. https://doi.org/10.1063/1.531249

[28] E. Verlinde, *On the Origin of Gravity*, JHEP, 2011. https://doi.org/10.1007/JHEP04(2011)029

[29] F. Hoyle, *A New Model for the Expanding Universe*, MNRAS, 1948. https://doi.org/10.1093/mnras/108.5.372

[30] H. Bondi, T. Gold, *The Steady-State Theory*, MNRAS, 1948. https://doi.org/10.1093/mnras/108.3.252

[31] F. Zwicky, *On the Redshift of Spectral Lines*, Proc. Nat. Acad. Sci., 1929. https://doi.org/10.1073/pnas.15.10.773

[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. https://doi.org/10.1103/PhysRevD.59.043516

[35] J. Barrow, *Cosmologies with Varying Light Speed*, Phys. Rev. D, 1999. https://doi.org/10.1103/PhysRevD.59.043515

[36] A. Riess et al., *A Comprehensive Measurement of the Local Value of the Hubble Constant*, ApJ, 2022. https://doi.org/10.3847/2041-8213/ac5c5b

[37] DESI Collaboration, *DESI Year 1 Results*, 2025. https://arxiv.org/abs/2404.03002

[38] E. Di Valentino et al., *Planck Evidence for a Closed Universe*, Nat. Astron., 2021. https://doi.org/10.1038/s41550-019-0906-9

[39] P. Di Francesco et al., *Conformal Field Theory*, Springer, 1997.

[40] Particle Data Group, *Review of Particle Physics*, 2024. https://pdg.lbl.gov/

[41] CODATA, *Recommended Values of Fundamental Constants*, 2019. https://physics.nist.gov/cuu/Constants/

[42] D. Newell et al., *The CODATA 2017 Values of h, e, k, and N_A*, Metrologia, 2018. https://doi.org/10.1088/1681-7575/aa950a

[43] Muon g-2 Collaboration, *Measurement of the Anomalous Magnetic Moment of the Muon*, Phys. Rev. Lett., 2023. https://doi.org/10.1103/PhysRevLett.131.161802

[44] Fermilab, *Muon g-2 Results*, 2023. https://muon-g-2.fnal.gov/

[45] ATLAS Collaboration, *Measurements at the LHC*, 2023. https://atlas.cern/

[46] ATLAS Collaboration, *Higgs Boson Properties*, 2023. https://atlas.cern/

[47] CMS Collaboration, *Top Quark Measurements*, 2023. https://cms.cern/

[48] CMS Collaboration, *Heavy Ion Collisions*, 2024. https://cms.cern/

[49] ALICE Collaboration, *Quark-Gluon Plasma Studies*, 2023. https://alice-collaboration.web.cern.ch/

[50] M. Kasevich et al., *Atom Interferometry*, 2023.

[51] A. Ludlow et al., *Optical Atomic Clocks*, Rev. Mod. Phys., 2015. https://doi.org/10.1103/RevModPhys.87.637

[52] S. Brewer et al., *Al^+ Optical Clock*, Phys. Rev. Lett., 2019. https://doi.org/10.1103/PhysRevLett.123.033201

[53] LISA Collaboration, *LISA Mission*, 2017. https://www.lisamission.org/

[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. https://doi.org/10.1093/mnras/113.1.34

[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. https://arxiv.org/abs/2006.04822

[61] Muon g-2 Collaboration, *Final Report on the Anomalous Magnetic Moment of the Muon*, Fermilab, 2025. https://muon-g-2.fnal.gov/

[62] J. Pascher, *T0 Theory: Complete Framework*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/systemEn.pdf

[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. https://doi.org/10.1126/science.aap7706

[65] L. Morel et al., *Determination of α from Rubidium Atom Recoil*, Nature, 2020. https://doi.org/10.1038/s41586-020-2964-7

[66] T. Aoyama et al., *Theory of the Electron Anomalous Magnetic Moment*, Phys. Rep., 2020. https://doi.org/10.1016/j.physrep.2020.07.006

[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. https://doi.org/10.1103/PhysRevLett.100.120801

[69] J. Pascher, *Higgs Connection in T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Energie_En.pdf

[70] J. Pascher, *T0 Theory and SI Units*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_SI_En.pdf

[71] J. Pascher, *Gravitational Constant in T0 Framework*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Gravitationskonstante_En.pdf

[72] J. Pascher, *Fine Structure Constant Analysis*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Feinstruktur_En.pdf

[73] J.S. Bell, *Muon Studies*, 1966.

[74] J. Pascher, *Quantum Field Theory in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/QFT_En.pdf

[75] Planck Collaboration, *Planck 2018 Results*, A&A, 2018. https://doi.org/10.1051/0004-6361/201833910

[76] J. Pascher, *T0 Theory Foundations*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Grundlagen_En.pdf`

[77] J. Pascher, *Geometric Formalism in T0*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Geometrische_Kosmologie_En.pdf`

[78] A. Riess et al., *Hubble Constant Measurements*, ApJ, 2019. `https://doi.org/10.3847/1538-4357/ab1422`

[79] J. Pascher, *T0 Kosmologie*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Kosmologie_En.pdf`

[80] S. Hossenfelder, *Single Clock Video*, YouTube, 2025. `https://www.youtube.com/c/SabineHossenfelder`

[81] Various, *Video References*, 2025.

[82] C.S. Unnikrishnan, *Gravity Studies*, 2004.

[83] A. Peratt, *Plasma Cosmology*, 1992. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_peratt_En.pdf`

[84] J. Pascher, *T0 Time-Mass Extension*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_tm-erweiterung-x6_En.pdf`

[85] J. Pascher, *T0 g-2 Extension*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_g2-erweiterung-4_En.pdf`

[86] J. Pascher, *T0 Networks*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_netze_En.pdf`

[87] W. Adams, *Gravitational Redshift*, 1925. `https://doi.org/10.1073/pnas.11.7.382`

[88] N. Ashby, *Relativity in GPS*, Living Rev. Rel., 2003. `https://doi.org/10.12942/lrr-2003-1`

[89] B. Bertotti et al., *Cassini Doppler Test*, Nature, 2003. `https://doi.org/10.1038/nature01997`

[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. `https://doi.org/10.1103/PhysRev.124.925`

[93] P.A.M. Dirac, *Quantum Mechanics*, Proc. Roy. Soc., 1927. `https://doi.org/10.1098/rspa.1927.0039`

[94] P. Duhem, *Theory of Physics*, 1906.

[95] A. Einstein, *Special Relativity*, Ann. Phys., 1905. `https://doi.org/10.1002/andp.19053221004`

[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. https://doi.org/10.1103/RevModPhys.87.637

[104] J.C. Maxwell, *Treatise on Electricity and Magnetism*, 1873.

[105] S. McGaugh et al., *Radial Acceleration Relation*, Phys. Rev. Lett., 2016. https://doi.org/10.1103/PhysRevLett.117.201101

[106] P. Mohr et al., *CODATA Values*, Rev. Mod. Phys., 2016. https://doi.org/10.1103/RevModPhys.88.035009

[107] Particle Data Group, *Review of Particle Physics*, Prog. Theor. Exp. Phys., 2020. https://pdg.lbl.gov/

[108] R. Parker et al., *Measurement of α*, Science, 2018. https://doi.org/10.1126/science.aap7706

[109] M. Peskin and D. Schroeder, *QFT*, 1995.

[110] M. Planck, *Quantum Theory*, 1900.

[111] Planck Collaboration, *Planck 2020 Results*, 2020. https://doi.org/10.1051/0004-6361/201833910

[112] H. Poincaré, *Dynamics of the Electron*, 1905.

[113] R.V. Pound and G.A. Rebka, *Gravitational Redshift*, Phys. Rev. Lett., 1960. https://doi.org/10.1103/PhysRevLett.4.337

[114] W.V. Quine, *Two Dogmas of Empiricism*, 1951.

[115] T. Quinn et al., *Gravitational Constant*, 2013. https://doi.org/10.1103/PhysRevLett.111.101102

[116] L. Randall and R. Sundrum, *Extra Dimensions*, Phys. Rev. Lett., 1999. https://doi.org/10.1103/PhysRevLett.83.3370

[117] A. Riess et al., *Type Ia Supernovae*, AJ, 1998. https://doi.org/10.1086/300499

[118] I. Shapiro et al., *Time Delay Test*, Phys. Rev. Lett., 1971. https://doi.org/10.1103/PhysRevLett.26.1132

[119] A. Sommerfeld, *Fine Structure*, 1916.

[120] S. Suyu et al., *Time Delay Cosmography*, MNRAS, 2017. `https://doi.org/10.1093/mnras/stx483`

[121] J. Pascher, *T0 Theory*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/systemEn.pdf`

[122] J. Pascher, *Fine Structure in T0*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Feinstruktur_En.pdf`

[123] J.-P. Uzan, *Constants Variation*, Rev. Mod. Phys., 2003. `https://doi.org/10.1103/RevModPhys.75.403`

[124] J.K. Webb et al., *Fine Structure Constant*, Phys. Rev. Lett., 2001. `https://doi.org/10.1103/PhysRevLett.87.091301`

[125] S. Weinberg, *Cosmological Constant*, Rev. Mod. Phys., 1979.

[126] S. Weinberg, *Cosmological Constant Problem*, 1989. `https://doi.org/10.1103/RevModPhys.61.1`

[127] S. Weinberg, *Quantum Theory of Fields*, 1995.

[128] C. Will, *Theory and Experiment in Gravitational Physics*, 2014. `https://doi.org/10.12942/lrr-2014-4`

[129] P.A.M. Dirac, *Principles of Quantum Mechanics*, 1930.

[130] A. Einstein, *Cosmological Considerations*, 1917.

[131] JWST Collaboration, *Early Universe Observations*, 2023. `https://www.jwst.nasa.gov/`

[132] KATRIN Collaboration, *Neutrino Mass*, 2022. `https://doi.org/10.1038/s41567-021-01463-1`

[133] J. Pascher, *T0 Fundamentals*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Grundlagen_En.pdf`

[134] J. Pascher, *g-2 Analysis Rev9*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Anomale-g2-9_En.pdf`

[135] J. Pascher, *ML Addendum*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0-QFT-ML_Addendum_En.pdf`

[136] J. Pascher, *Beta Derivation*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/DerivationVonBetaEn.pdf`

[137] J. Pascher, *CMB Analysis in T0*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Zwei-Dipole-CMB_En.pdf`

[138] J. Pascher, *Cosmos in T0 Theory*, 2025. `https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/cosmic_En.pdf`

[139] J. Pascher, *Derivation of Beta*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/DerivationVonBetaEn.pdf

[140] J. Pascher, *Gravitation in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/gravitationskonstante_En.pdf

[141] J. Pascher, *Lagrangian in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_lagrndian_En.pdf

[142] J. Pascher, *Lagrangian Framework*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/LagrandianVergleichEn.pdf

[143] J. Pascher, *Extended Lagrangian Formalism*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_lagrndian_En.pdf

[144] J. Pascher, *Mathematical Structure of T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Mathematische_struktur_En.pdf

[145] J. Pascher, *Muon g-2 in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Anomale-g2-9_En.pdf

[146] J. Pascher, *Pragmatic Approach*, 2025.

[147] J. Pascher, *T0 Energy Formalism*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0-Energie_En.pdf

[148] J. Pascher, *Unified T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_unified_report.pdf

[149] Science Daily, *Physics News*, 2025. https://www.sciencedaily.com/

[150] S. Weinberg, *The Cosmological Constant Problem*, Rev. Mod. Phys., 1989. https://doi.org/10.1103/RevModPhys.61.1

[151] Wikipedia, *Bell's Theorem*, 2025. https://en.wikipedia.org/wiki/Bell%27s_theorem

[152] B. van Fraassen, *The Scientific Image*, Oxford University Press, 1980.

[153] J. Terrell, *Single Clock Nature*, Nature, 2024.

[154] J. Pascher, *The Number 137 in T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/137_En.pdf

[155] J. Pascher, *Ampere's Law in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Amper_Low_En.pdf

[156] J. Pascher, *Bell's Theorem in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Bell_En.pdf

[157] J. Pascher, *Kinetic Energy in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Bewegungsenergie_En.pdf

[158] J. Pascher, *E=mc² in T0 Framework*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/E-mc2_En.pdf

[159] J. Pascher, *Energy-Based Formulas*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Formeln_Energiebasiert_En.pdf

[160] J. Pascher, *Hannah Document*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Hannah_En.pdf

[161] J. Pascher, *H0 Analysis*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Ho_En.pdf

[162] J. Pascher, *Markov Processes in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Markov_En.pdf

[163] J. Pascher, *Elimination of Mass*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/EliminationOfMassEn.pdf

[164] J. Pascher, *Dirac Equation Mass Elimination*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Elimination_Of_Mass_Dirac_TabelleEn.pdf

[165] J. Pascher, *Fine Structure Constant*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/FeinstrukturkonstanteEn.pdf

[166] J. Pascher, *Neutrino Formula*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/neutrino-Formel_En.pdf

[167] J. Pascher, *Neutrinos in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Neutrinos_En.pdf

[168] J. Pascher, *Koide Formula in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_koide-formel-3_En.pdf

[169] J. Pascher, *Particle Masses*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Teilchenmassen_En.pdf

[170] J. Pascher, *T0 Particle Masses*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Teilchenmassen_En.pdf

[171] J. Pascher, *Penrose Analysis in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_penrose_En.pdf

[172] J. Pascher, *Photon Chip Implementation*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_photonenchip-china_En.pdf

[173] J. Pascher, *Three Clock Experiment*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_threeclock_En.pdf

[174] J. Pascher, *Redshift and Deflection*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/redshift_deflection_En.pdf

[175] J. Pascher, *Apparent Instantaneity*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/scheinbar_instantan_En.pdf

[176] J. Pascher, *Universal Derivation*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/universale-ableitung_En.pdf

[177] J. Pascher, *Xi Parameter for Particles*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/xi_parmater_partikel_En.pdf

[178] J. Pascher, *Origin of Xi*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_xi_ursprung_En.pdf

[179] J. Pascher, *Time in T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Zeit_En.pdf

[180] J. Pascher, *Time Constant*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Zeit-konstant_En.pdf

[181] J. Pascher, *Summary of T0 Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Zusammenfassung_En.pdf

[182] J. Pascher, *RSA in T0 Framework*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/RSA_En.pdf

[183] J. Pascher, *Quantum Atomic Theory*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_QAT_En.pdf

[184] J. Pascher, *QM, QFT and RT Unification*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_QM-QFT-RT_En.pdf

[185] J. Pascher, *QM Optimization*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_QM-optimierung_En.pdf

[186] J. Pascher, *Complete Calculations*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Vollstaendige_Berchnungen_En.pdf

[187] J. Pascher, *T0 Theory vs Synergetics*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0-Theory-vs-Synergetics_En.pdf

[188] J. Pascher, *T0 Model Overview*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Modell_Uebersicht_En.pdf

[189] J. Pascher, *MNRAS Analysis*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Analyse_MNRAS_Widerlegung_En.pdf

[190] J. Pascher, *Anomalous Magnetic Moments*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_Anomale_Magnetische_Momente_En.pdf

[191] J. Pascher, *Seven Questions in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_7-fragen-3_En.pdf

[192] J. Pascher, *Detailed Lepton Anomaly*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/detailierte_formel_leptonen_anemal_En.pdf

[193] J. Pascher, *Parameter Derivation*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/parameterherleitung_En.pdf

[194] J. Pascher, *Absolute Ratios in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_verhaeltnis-absolut_En.pdf

[195] J. Pascher, *Xi and Energy*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_xi-und-e_En.pdf

[196] J. Pascher, *Inversion in T0*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0_umkehrung_En.pdf

[197] J. Pascher, *T0 vs ESM Conceptual Analysis*, 2025. https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/T0vsESM_ConceptualAnalysis_En.pdf