T≡M Theory — Time Is Motion: Cosmological Expansion as the Root Tick

Time as Hierarchical Motion Nested within Cosmological Expansion (Root Tick Θ)

Author: Mateo Moreira

Country: Uruguay

Email: mateomoreira@gmail.com

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Dedicated to: my son and my wife, my guides in the Tempo.

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Author's note

I do not come from the scientific or academic world. This theory comes from a long-held intuition: **time is motion**. In my v1.0 I tried to express it with words. In this manuscript I try to express it with a more technical structure without losing my way of speaking.

My idea does not start from formulas; it starts from a conceptual conviction. I believe the universe is not "inside" time. I believe **time is the motion of the universe**, the **Tempo**, and that if that motion were to stop completely, there would be no "empty time" left: there would be **total pause**.

I also clarify something important: much of the order, notation, and formalization was produced with **AI assistance**, because my expertise in physics is limited. I do not present this as a closed result, but as an invitation to criticism and review. My goal is to express the idea in a way that is minimally compatible with physics and cosmology, so it can be discussed with rigor.

I also clarify that the suggestions about "how this could be tested" (a minimal atomic-clock program and a residual parameterization) do not come from my technical knowledge; they were formulated with **AI assistance** as a way to translate my intuition into a testable language. I include the experiment outline as a guide for those who do have expertise.

This manuscript is open to review: corrections, counterexamples, formalization suggestions, and proposals for how to connect the root tick to real observables.

Abstract

I propose a framework where **Time (Tempo)** is not an independent entity, but is **identical to universal motion**. In this version I make a more concrete claim: the **root tick** of Tempo is **cosmological expansion**, represented as accumulated expansion Θ.

All local motions—from astronomical scales down to the smallest scales—exist as **nested motions** inside that root tick. That is why different clocks can measure different "elapsed time": they do not measure an external container, but **internal motion counts**.

I also introduce an operational concept: the **minimal event** $E_{\min}$, defined here by its **functional role** (not by a microphysical ontology). In the limit, if the minimal event is null, local change is null: **total pause**. Instead of trying to "turn off the universe," I propose a testable path: study how local counts of clock-processes N_R relate to the root tick Θ through relations like $dN_R/d\Theta$, and introduce a quantifiable residual term that can be bounded by data.

What is conviction and what is experiment

This manuscript mixes three layers, and I separate them so we don't confuse them:

- **Conviction / Ontology:** how I interpret what time is (my base idea: Tempo ≡ motion).
- **Synthesis:** a conceptual re-organization using language compatible with known physics (using Θ as the root tick, clocks as counts).
- **Experiment (weak hypothesis):** a minimal extension that, if it exists, could be bounded by data (the residual parameter α_R in equation (8)).

Central idea (no detours)

Tempo ≡ universal motion.

And the **root motion** (the most fundamental tick) is **cosmological expansion**.

Everything else is **nested motion** inside that root: subfolders inside a parent folder.

T≡M postulates (the minimum I claim)

T≡M-0 — Identity

Time (Tempo) is identical to the motion/change of the universe; it does not exist as a separate entity.

T≡M-1 — Root tick

The **root tick** of Tempo is identified with cosmic becoming: the **expansion of the universe**.

T≡M-2 — Nested motion

Local motions are **nested motions**: they occur inside the advance of the root tick, across levels (cosmological, astrophysical, planetary, biological, microscopic, etc.).

T≡M-3 — Minimal event and no-pause

There exists a form of **minimal activity** required for local change to exist. If that minimal activity is null, local change is null (**total pause**).

The root tick Θ: how I write it without inventing "a clock"

Cosmological expansion can be expressed as an accumulated quantity. I take it as the root tick of Tempo.

$$\Theta = \ln(a/a_0)$$

(1)

$$\Theta = -\ln(1+z)$$

(2)

- a: scale factor
- a_0: reference
- z: redshift

In this framework, it is not that Θ "measures" time: Θ **is the tick of Time**.

Cosmological scope: when I say "expansion" in T≡M, I mean the universe at large scales under the standard cosmological approximation of homogeneity/isotropy (FLRW-type). My "root tick" Θ is meant to describe the global average becoming of the universe, not local details.

Coordinates vs foundation: in cosmology one often writes $a(t)$, but in T≡M I do not take t as fundamental; I take it as a useful coordinate. The point of T≡M is interpretive: Θ represents the root tick of becoming, and usual time parametrizations are used as descriptive convenience, not as the primary ontological entity.

Nested motion

Let X be a representation of the physical state of the universe. I consider the elemental change dX without introducing "per unit time".

To express the idea without committing to a strict mathematical sum, I use "+" as **conceptual composition** (not as literal numerical addition). If the reader prefers, it can be read as "combination" or "level-decomposition".

$$dX = dX_{\text{root}} + dX_{\text{local}}$$

(3)

$$dX_{\text{local}} = \sum_{k\geq 1} dX_k$$

(4)

- dX_{root} is associated with the advance of Θ.
- dX_k represents motions at internal levels: from cosmological down to microscopic.

About the decomposition: the form (3)–(4) is not presented as a mathematical theorem nor as a strict sum of magnitudes. It is a conceptual map: root → levels → counts. My goal is to capture the hierarchy of motions as an interpretive structure of Tempo.

Minimal event $E_{\min}$

Functional definition

In this version I do not define $E_{\min}$ by saying "it is decoherence" or "it is some specific interaction." That would commit to a microphysics I do not yet have.

Instead, I define it by its role:

> **Definition:** $E_{\min}$ is the elemental event that increments a counter $N_{\min}$ and represents the minimal unit of physical activity required for locally observable change to exist within the root tick.

Minimal counter

I introduce $N_{\min}$ as an accumulated counter of minimal events.

Conjectures (what I want to be challenged on)

Strong conjecture — "Total pause"

Status of the strong conjecture: "total pause" is presented as a conceptual/ontological limit of T≡M. I do not offer it today as a direct laboratory prediction. The empirically discussable core is the weak conjecture and the residual parameter α_R in (8).

$$dN_{\min} = 0 \Rightarrow dX_k = 0 \ \ (\text{for all } k)$$

(5)

Interpretation: if minimal activity is null, local motion is null at any level. There is no "empty time" left: there is **total pause**.

And the root conditioning:

$$d\Theta > 0 \Rightarrow dN_{\min} > 0$$

(6)

Weak conjecture — Relation between clocks and the root tick

The testable path is to study the relation between local counts and Θ.

Let R be a clock-process with counter N_R. Central object:

$$\frac{dN_R}{d\Theta} = F_R(\text{local conditions})$$

(7)

To have a more defined quantitative bridge, I propose a minimal ansatz with a boundable residual term:

$$\frac{dN_R}{d\Theta} = \kappa_R(1 + \alpha_R) + \delta_R(\text{conditions})$$

(8)

- κ_R: intrinsic scale of clock R.
- δ_R: corrections from local conditions (gravity, velocity, environment).
- α_R: residual parameter (if it exists) associated with T≡M in its weak version.

Minimal choice: in this v2.0 I adopt the simplest case $G(\Theta) = 1$ to avoid arbitrariness. Other possible dependencies (e.g., $G(\Theta) = \Theta$) are left as future work.

Clear reading:

- If $\alpha_R = 0$, T≡M remains an ontological/synthesis framework.
- If $\alpha_R \neq 0$ and appears consistently, T≡M gains additional physical content.

Figure 1 (conceptual toy model)

Toy model (conceptual):

- **Clock A:** $N_A(\Theta) = \kappa_A \Theta$
- **Clock B:** $N_B(\Theta) = \kappa_B \Theta + \epsilon, g(\text{environment})$
- **Clock C:** $N_C(\Theta) = \kappa_C \Theta + \beta \Theta^2$

More concrete version (still without numbers):

- R can be an atomic clock (Cs, Sr, Yb), a pulsar, or a stable nuclear process.
- The relevant comparison is not "seconds," but how counts N_R evolve with respect to Θ.

How it could be tested (minimal program)

If someone with expertise wanted to test the weak version of T≡M, I propose a minimal program (without inventing numbers):

- **Choose concrete clocks R:** for example, two different atomic clocks (Cs vs Sr/Yb, or Sr vs Yb).
- **Practical observable:** the **frequency ratio** ν_1/ν_2 and its stability (this is what metrology actually compares).
- **Base model:** compute/fit all known effects (gravity, velocity, environment, systematics). This corresponds to $\delta_R(\text{conditions})$.
- **Minimal T≡M fit:** introduce the residual α_R in (8) as an additional constant deviation (in this v2.0).
- **Possible outcome A:** α_R is bounded to ~ 0 with increasingly strong limits (T≡M as ontology + empirical bounds).
- **Possible outcome B:** a consistent residual appears across configurations/epochs (which would be extraordinary and would demand physical formalization).

Note: if the outcome is "no signal," it still matters: it leaves T≡M as interpretation/synthesis with a strongly constrained experimental branch.

Compatibility with standard relativity/cosmology (interpretation)

I do not intend to replace standard cosmology or general relativity. I propose an ontological reading:

- Θ as the root tick.
- Clocks as nested sub-counts.
- A weak program (8) as a possible residual extension.

Empirical program and limits

Any universal residual coupling that manifests as fractional drift in frequencies or constants is strongly constrained by modern metrology (optical clocks at ~ 10^{-18} in stability/precision). The practical implication is that (8), if it adds a new effect, must be extremely small or null at already tested levels; still, "no detection" + quantitative bounds is also a result.

Methodological transparency and call for review

Part of the notation, structure, and experimental-contrast suggestions were developed with **AI assistance**, given my limited knowledge of physics. I present this as an open preprint: I welcome corrections, counterexamples, and review, especially regarding:

- Conceptual consistency.
- Minimal consistency with known physics/cosmology.
- How to formulate and bound α_R without mixing it with already-known effects.

Closing (my way of saying it)

In T≡M, the universe "Tempo-ed" from its beginning: by expanding, it initiated the root tick. Local motions do not occur "in" time; they constitute time as motions nested within cosmic becoming. If the minimal activity stopped, there would be no "empty time" left: there would be total pause.

Minimal references

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- Connes, A., & Rovelli, C. (1994). *Von Neumann algebra automorphisms and time-thermodynamics relation in generally covariant quantum theories*.
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- Sherrill, N., et al. (2023). *Analysis of atomic-clock data to constrain variations of fundamental constants*.

Appendix — Minimal notation

- a: cosmological scale factor
- z: redshift
- $\Theta = \ln(a/a_0) = -\ln(1+z)$: root tick (cosmological Tempo)
- X: universe state; dX: elemental change
- $E_{\min}$: minimal event; $N_{\min}$: minimal counter
- R: local clock-process; N_R: process count
- α_R: residual parameter (if it exists)

Numbered equations

(1)–(2) definition of Θ

(3)–(4) nested structure

(5)–(6) strong conjecture

(7) general relation

(8) minimal ansatz with a boundable parameter
