Universal Time and Tick Suppression: A Realist Interpretation of Relativistic Effects

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Abstract

We present a realist reinterpretation of relativistic phenomena, *Universal Time and Tick Suppression*. Time is taken not as an observer–relative parameter but as a universal, dynamic axis: a smooth future-directed timelike field U along which the total mass–energy of the universe advances. Effects usually described as "time dilation" are recast as *tick suppression*: a physical slowing of internal processes (clocks, decays) due to the energy cost of sustaining motion through space or persisting in gravitational fields. This energy–allocation mechanism is formalized as the *Inertial Suppression Principle*, providing a causal reading that is operationally equivalent to standard relativity while ontologically distinct. We also specify a light-based calibration of duration, using local MCIFs and c, that is independent of potentially suppressed clocks. The framework unifies kinematic and gravitational slowdowns under a single mechanism, preserves all empirical predictions, and offers a clear, absolute (yet physical) notion of time that clarifies puzzles of simultaneity without altering relativistic phenomenology.

Overview

This framework proposes a physically objective interpretation of time [1]. Rather than viewing time as relative to different observers, the theory presents the following core principles:

- There is one shared reality.
- There is one universal time.

- Observable phenomena, such as clocks running slower or particles decaying more slowly, are real effects on physical processes, not on time itself.

The key claim is that **processes slow down**, not time. Everything in the universe unfolds along the same universal time axis, and effects seen in high-speed or high-gravity environments reflect changes in the systems involved, not a change in the passage of time [4, 5].

The Geometric Structure of Cosmic Time

This theory posits a fundamental, geometrically explicit universal time axis, denoted by the parameter T. This parameter foliates spacetime into hypersurfaces of constant cosmic time. This foliation is not arbitrary but is defined by the congruence of worldlines representing the flow of the universe's total mass-energy content, described by a smooth, future-directed timelike 4-velocity field U^μ [5].

Time as a Dynamic Axis

Time is the universe's dynamic axis: a physical direction in spacetime, anchored at the agreed start (O, Σ_0), along which all mass–energy evolves [4].

The relationship between this universal time and local spatial dimensions can be intuitively visualized through a Euclidean analogy. Consider the vector representing the direction of temporal advancement in a 3D space:

$$\vec{T} = (1, 1, 1).$$

This vector is equally inclined to the x, y, and z axes. The angle θ between $\vec{T}$ and any spatial axis is given by:

$$\cos\theta = \frac{\vec{T} \cdot \hat{x}}{|\vec{T}|} = \frac{1}{\sqrt{3}} \quad \Rightarrow \quad \theta = \arccos\left(\tfrac{1}{\sqrt{3}}\right) \approx 54.7^\circ.$$

Interpretation. This diagonal vector is a metaphorical illustration of the timelike direction U^μ orthogonal to the cosmic time foliation. *This analogy is purely illustrative; no preferred spatial axes are implied.* It symbolizes that the progression of cosmic time is a global property that exerts a fundamental influence on all local spatial dimensions, without implying a privileged spatial frame. The physical reality is the 4-velocity field U^μ and the foliation it defines, not a literal diagonal in a Euclidean space.

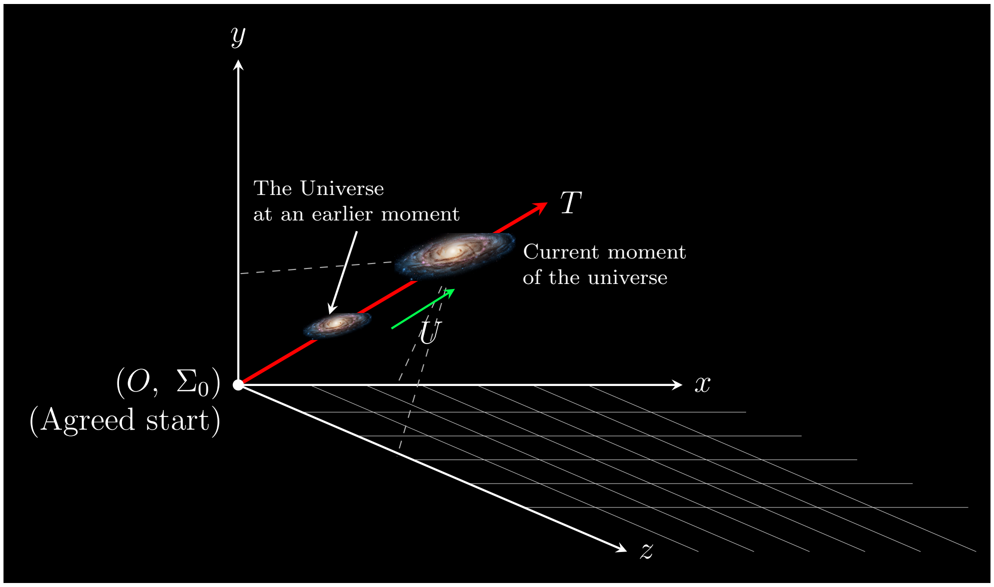


Figure 1: The universal time axis T represents the trajectory of the universe's total mass-energy. The red line denotes cosmic time [3], flowing from the physical start Σ_0. Each galaxy represents the state of the entire universe at a specific moment on the cosmic timeline. This model treats "earlier universe" and "universe now" as distinct states along a single, objective timeline, not as frames in a relative perspective.

This model fundamentally reorients the view of time: "earlier universe" and "universe now" are not different frames of reference, but distinct states along a single, objective timeline governing the entire cosmos [10].

1 Time, Moment, Interval, and Duration

Conceptual Definitions

A central pillar of this framework is the rigorous distinction between the often-conflated concepts of *time*, *moment*, and *duration*. Before presenting the mathematical formalism, we fix terminology:

- **Time** (T) answers "when?". Operationally, it is the scalar field that orders events. Physically, its level sets Σ_T foliate spacetime; on any open domain where the mass–energy flow U is hypersurface–orthogonal, U is the future–directed unit normal to these slices (i.e., $U[T] = 1$).

- A **Moment** is a specific event in the universe, a point in both space and time.
  - **Space** (x, y, z) are the three coordinates that tell you *where* the event happens.

  Together, these four coordinates (T, x, y, z) uniquely identify a single moment in the four–dimensional continuum of spacetime.

- **Universal Time Interval** is the fixed and absolute length along the universal time axis (T) between an agreed starting moment and an agreed ending moment.

- **Duration** is the comparison of how long a process unfolds relative to the invariant propagation of light within the same universal time interval; it is the answer to "how long?".

Mathematical Formalism

Let spacetime be a time–orientable Lorentzian manifold $(\mathcal{M}, g)$ [5].

Remark 1 (Scope)**.** *All statements hold on a domain $\mathcal{U}$ that is globally hyperbolic with sufficiently small vorticity so that the mass–energy congruence U is hypersurface–orthogonal to $\{\Sigma_T\}$.*

Notation.

- $\gamma(v) = \dfrac{1}{\sqrt{1 - v^2/c^2}}$: Lorentz factor from Eulerian 3–speed.

- $\gamma_{\mathrm{rel}} = -u^\mu n_\mu \geq 1$: The general, covariant gamma factor; reduces to $\gamma(v)$ in the appropriate frame.

- $\alpha = \gamma_{\mathrm{rel}}^{-1} \in (0, 1]$: The relativistic conversion coefficient (ideal "ticks per unit T").

- $S = \dfrac{N}{\gamma_{\mathrm{rel}}}\, s_{\mathrm{tick}}(\mathcal{C})$: The total suppression factor, including the gravitational lapse N and the device factor s_{tick}.

Definition 1 (Time)**.** *A (universal)* ***time field*** *is a smooth scalar $T : \mathcal{M} \to \mathbb{R}$ whose gradient $\nabla_\mu T$ is timelike and future-pointing on an open domain $\mathcal{D} \subseteq \mathcal{M}$. The level sets*

$$\Sigma_T := \{\, p \in \mathcal{D} \mid T(p) = \mathrm{const} \,\} \tag{1}$$

foliate $\mathcal{D}$ into hypersurfaces of constant universal time.

Definition 2 (Cosmic flow field)**.** *A smooth, future–directed time–like unit vector field U^μ on $\mathcal{D}$ represents the mass–energy congruence, chosen so that $U[T] = 1$. MCIF(U) denotes a momentarily comoving inertial frame of U.*

Remark 2. *The universal time coordinate T is not an abstract parameter but is physically anchored to the single, ongoing transformation of the universe. All systems and observers share the same advance dT between two slices Σ_T and Σ_{T+dT}, which underwrites its observer-independent character. This distinguishes it from the path-dependent proper duration $d\tau$, which measures the internal evolution of a specific subsystem [2].*

Definition 3 (Moment (Event))**.** *A* ***moment*** *is an event $p \in \mathcal{M}$, uniquely identified in coordinates adapted to the foliation by $(T(p), \vec{x}(p))$.*

Definition 4 (Universal Time Interval)**.** *On a domain $\mathcal{D} \subseteq \mathcal{M}$ admitting the T–foliation, for $p_1 = (T_1, \vec{x}_1)$, $p_2 = (T_2, \vec{x}_2) \in \mathcal{D}$ with $T_2 \geq T_1$,*

$$\Delta T(p_1, p_2) = T_2 - T_1 \geq 0, \qquad |\Delta T| = |T_2 - T_1| \tag{2}$$

ΔT is path-independent and depends only on T_1, T_2 (not on spatial positions).

Definition 5 (Duration (light-based calibration))**.** *We define duration without relying on physical clocks, using light propagation as the universal invariant [1, 4]:*

1. *Fix the universal foliation via T (with $U[T] = 1$, $T|_{\Sigma_0} = 0$). Choose two events S and E on the same U flow line, with $T_S := T(S)$ and $T_E := T(E)$.*

2. *Along that worldline, in each local MCIF(U), a co-located light pulse satisfies $dt_{\text{MCIF}} = d\ell^{\text{MCIF}}_{\text{light}}/c$.*

3. ***Calibration of** T**.** We affinely fix T so that along U,*

$$dT \;\equiv\; \frac{d\ell^{\text{MCIF}(U)}_{\text{light}}}{c}, \quad \Rightarrow \quad \Delta T(S, E) = \int_{T_S}^{T_E} \frac{d\ell^{\text{MCIF}(U)}_{\text{light}}}{c}. \tag{3}$$

   Thereafter we use dT as the universal duration unit.

4. *For any timelike worldline γ and a clock B carried along it,*

$$\Delta\tau_B \;=\; \int_{T_S}^{T_E} S(\gamma)\, dT \;=\; \int_{T_S}^{T_E} \alpha(v, \Phi)\; s_{\text{tick}}(\gamma)\; dT \;\leq\; \Delta T(S, E), \tag{4}$$

where $\alpha(v, \Phi) \in (0, 1]$ *is the kinematic/gravitational conversion coefficient (where* v *is the 3-velocity measured by the* T*−adapted orthonormal triad), and* $s_{\text{tick}}(\gamma) \in (0, 1]$ *is a device/material factor.*

Remark 3 (Device factor)**.** *The factor* $s_{\text{tick}}(\gamma) \in (0, 1]$ *models non-relativistic imperfections of a physical clock. An* ideal *atomic clock has* $s_{\text{tick}} = 1$*, so* $S = \alpha$ *and the reading reflects only relativistic suppression. Unless otherwise stated, we set* $s_{\text{tick}} = 1$ *in derivations.*

Remarks. (i) The calibration is local and valid in curved spacetime. (ii) Light provides the invariant upper bound for duration: for timelike motion, $d\tau \leq dT$.

The suppression factor is thus

$$S(\gamma) := \frac{d\tau}{dT} = \alpha(v, \Phi)\; s_{\text{tick}}(\gamma) \in [0, 1], \tag{5}$$

and the total reported duration over $[T_{\text{start}}, T_{\text{end}}]$ is

$$\Delta\tau_{\text{clk}}(\gamma) = \int_{T_{\text{start}}}^{T_{\text{end}}} \alpha(v, \Phi)\; s_{\text{tick}}(\gamma)\; dT \;\leq\; \Delta T. \tag{6}$$

Summary

A duration exists only for a completed process bounded by two universal moments T_{start} and T_{end}. By contrast, the universal time T advances unboundedly as the universe transforms.

When did it occur? $\Rightarrow$ **Time:** T (global foliation).

Where + when? $\Rightarrow$ **Moment:** $(T, x, y, z) \in \mathcal{M}$.

How long did it take? $\Rightarrow$ **Universal Time Interval:** $\Delta T = T_{\text{end}} - T_{\text{start}}$.

Clock reading: $\Rightarrow$ **Suppressed duration:** $\Delta\tau = \int_{T_{\text{start}}}^{T_{\text{end}}} \alpha(v, \Phi)\,,$

$s_{\text{tick}}(\gamma)\, dT \;\leq\; \Delta T$.

Time flows universally; clocks attempt to track it. Only light defines the invariant standard.

Cosmological Anchoring of the Universal Time

To anchor the universal time axis T in modern cosmology, we define the cosmic flow field U^μ operationally as the congruence of observers for whom the Cosmic Microwave Background (CMB) is isotropic – that is, those with a vanishing CMB dipole, defining the "cosmic rest frame" [4].

On a cosmological domain $\mathcal{U}_{\cos}$ that is well-approximated by an FLRW model, this U^μ is the comoving congruence U^μ_{CMB}, which defines standard *cosmic time*, $t_{\cos}$, via the metric:

$$ds^2 = -c^2\,dt_{\cos}^2 + a^2(t_{\cos})\,d\ell^2.$$

In this framework, we identify the universal time T with this observable cosmic time:

$$T \equiv t_{\cos} + \text{const}.$$

The hypersurfaces of constant universal time, Σ_T, thus coincide with the standard FLRW homogeneity slices. This construction is assumed to hold on a domain that is globally hyperbolic with sufficiently small vorticity, such that U^μ is hypersurface-orthogonal.

For an observer in this spacetime, variations in accumulated duration are encoded in the suppression factor S, which accounts for their peculiar velocity v_{pec} relative to the cosmic rest frame and any local gravitational potential:

$$d\tau \;=\; S\,dT, \qquad S \;=\; \sqrt{1-\frac{v_{\text{pec}}^2}{c^2}} \;\times\; \sqrt{-g_{00}(\mathbf{x})},$$

where we assume an ideal clock ($s_{\text{tick}} = 1$) and v_{pec} is the physical 3–velocity measured by Eulerian observers.

This resolves the apparent paradox of "motion in an expanding universe": comoving galaxies separate because *proper distances between worldlines on* Σ_T *grow* (Hubble flow), yet they are not "moving through space" relative to the cosmic rest frame [4]. Expansion per se does not induce tick suppression; only peculiar motion and local gravitational potentials do. This amounts to a *preferred temporal foliation (CMB–comoving), not a material ether or spatial rest medium.*

The Physical Mechanism of Tick Suppression

This framework reinterprets relativistic phenomena not as variations in the fabric of time itself, but as physical changes in the rate at which material systems undergo internal processes [1, 3]. The effect, *tick suppression*, is governed by the principles laid out below.

Principle of Mass–Energy Coupling (The "Axiom of Existential Tethers")

The degree to which a physical system is coupled to the universal time axis T is determined by its mass–energy. This coupling facilitates the system's internal processes ("ticks"). To have rest mass is to support internal transformation, with the rest energy

$$E_0 = mc^2 \tag{7}$$

setting the unsuppressed baseline tick rate in the T–gauge (idealized $s_{\text{tick}} = 1$).

Any deviation from co-motion with the universal flow – either through motion or gravity – tilts the system's four-velocity u^μ relative to the slice normal n^μ. This reduces the projection

$$S = \frac{d\tau}{dT}, \tag{8}$$

suppressing the conversion of universal time dT into proper duration $d\tau$.

Remark 4 (Interpretation)**.** *Phrases like "energy cost" are interpretive. No continuous work is required to maintain inertial motion or a static position in a gravitational field. The reduction $S = d\tau/dT$ (cf. (5)) is a direct consequence of the system's geometric state, not a new dynamical law.*

The General Suppression Factor

The total suppression factor S unifies all relativistic effects. In the T–adapted 3+1 formalism, the metric takes the form

$$ds^2 = -N^2 dT^2 + h_{ij}(dx^i + N^i dT)(dx^j + N^j dT). \tag{9}$$

For an object with physical 3-velocity v (as measured by Eulerian observers), the suppression factor for an ideal clock ($s_{\text{tick}} = 1$) is

$$S = \alpha(v, \Phi) = \frac{N}{\gamma_{\text{rel}}(v)}, \qquad \gamma_{\text{rel}}(v) = \frac{1}{\sqrt{1 - v^2/c^2}}. \tag{10}$$

This is the full relativistic conversion coefficient used throughout (cf. (13)). It reduces to the well-known limits:

- **Purely Kinematic (Flat Spacetime):** In a region with no gravity, the lapse is trivial ($N = 1$), and suppression is purely due to motion:

$$S = \frac{1}{\gamma_{\rm rel}(v)} = \sqrt{1 - \frac{v^2}{c^2}} \tag{11}$$

  Thus the proper-time rate is explicitly

$$d\tau \;=\; \sqrt{1 - \tfrac{v^2}{c^2}}\, dT \;\le dT, \tag{12}$$

  with equality only in the unsuppressed limit ($v = 0$, ideal $s_{\rm tick} = 1$).

- **Purely Gravitational (Static Observer):** With $v = 0$ ($\gamma_{\rm rel} = 1$), suppression is $S = N$. In a static spacetime, this becomes the exact factor

$$S = \sqrt{-g_{00}}, \tag{13}$$

  and in the weak-field limit with Newtonian potential $\Phi < 0$,

$$S \;\approx\; \sqrt{1 + \tfrac{2\Phi}{c^2}}\,. \tag{14}$$

The Massless Limit

A massless particle like a photon has no rest mass and therefore no coupling to the T–axis to support internal processes. Its suppression is maximal ($S = 0$), and its proper time vanishes identically:

$$d\tau = 0. \tag{15}$$

The speed of light c is thus the null limit separating massive (timelike) and massless (null) worldlines. For any massive object, the $v \to c$ limit is unattainable with finite energy.

Application: The Twin Paradox

To demonstrate the framework's explanatory power, we apply it to the classic Twin Paradox. The key distinction is between the fixed *Universal Time Interval* ΔT and the path-dependent accumulated duration $\Delta\tau$.

Setup

- **Gauge Fixing.** Adapt the universal time T to the stay-at-home twin (Eulerian, slice–normal, ideal, unsuppressed), so that along this worldline $S = 1$ and $dT = d\tau$.

- **Suppression/Conversion Factor.** For any process along a timelike worldline $\mathcal{C}$,
$$S(\mathcal{C}) := \alpha(v, \Phi)\, s_{\text{tick}}(\mathcal{C}) \ \in \ (0, 1], \tag{16}$$
where $\alpha(v, \Phi)$ is the standard kinematic/gravitational conversion coefficient ("ticks per unit T"). Here v denotes the *physical* 3–velocity measured by Eulerian observers (the T–adapted orthonormal triad). In flat spacetime ($\Phi = 0$),
$$\alpha(v, \Phi) = \sqrt{1 - \tfrac{v^2}{c^2}}. \tag{17}$$
In static fields with lapse $N = \sqrt{-g_{00}}$,
$$\alpha(v, \Phi) = N \sqrt{1 - \tfrac{v^2}{c^2}}. \tag{18}$$
For ideal atomic clocks, set $s_{\text{tick}} = 1$.

- **Measured Duration.** The accumulated ticks are
$$\Delta\tau(\mathcal{C}) \ = \ \int_{\mathcal{C}} S\, dT \ = \ \int_{\mathcal{C}} \alpha\, dT \qquad \text{(ideal clocks)}. \tag{19}$$

Stay-at-Home Twin. For the home twin's worldline $\mathcal{C}_{\text{home}}$, the gauge choice gives $S = \alpha = 1$ throughout. Thus
$$\Delta\tau_{\text{home}} = \int_{\mathcal{C}_{\text{home}}} 1\, dT \ = \ \Delta T. \tag{20}$$

Traveling Twin. Consider an out-and-back at constant speed v in flat spacetime. Then
$$\alpha(v) = \sqrt{1 - \tfrac{v^2}{c^2}} \ < \ 1, \tag{21}$$
so over the same universal interval ΔT,
$$\Delta\tau_{\text{trav}} = \int_{\mathcal{C}_{\text{trav}}} \alpha\, dT = \sqrt{1 - \tfrac{v^2}{c^2}}\, \Delta T \ < \ \Delta T. \tag{22}$$

(*Turnaround.* An instantaneous turnaround contributes no T–measure; for finite accelerations, the integral above still yields the same inequality.)

Resolution

There is a fixed Universal Time Interval ΔT between departure and reunion, but the accumulated ticks $\Delta\tau = \int S\,dT$ are path-dependent. The traveling twin has a *smaller conversion factor* $\alpha(v)$ (fewer ticks per unit T), hence

$$\Delta\tau_{\text{home}} - \Delta\tau_{\text{trav}} = \left(1 - \sqrt{1 - \tfrac{v^2}{c^2}}\right) \Delta T \;\geq\; 0. \tag{23}$$

No "time itself" slowing – just different path-integrated suppression.

Numerical Example

For $v = 0.8c$ and $\Delta T = 10$ years:

$$\alpha = \sqrt{1 - 0.8^2} = 0.6, \quad \Delta\tau_{\text{home}} = 10 \text{ yr}, \quad \Delta\tau_{\text{trav}} = 0.6 \times 10 = 6 \text{ yr}. \tag{24}$$

The twin with the ideal conversion ($\alpha = 1$) accumulates the most duration and ends up older.

Remark 5 (No deviation from T)**.** *All observers share the same Universal Time Interval ΔT; the factor $\alpha(v, \Phi) \leq 1$ is a conversion coefficient ("ticks per unit T"), not a geometric deviation from T. Differences in aging arise solely from $S = \alpha\, s_{tick}$ via $d\tau = S\,dT$ (cf.* (5)*).*

Principle of Global–Local Decoupling (Postulate)

Postulate (Global temporal stability). On sufficiently large (cosmological) smoothing scales, there exists a smooth, future–directed timelike congruence U whose flow defines a foliation $\{\Sigma_T\}$ that is *stable under local, compact reconfigurations of mass–energy* [5]. Local interactions (collisions, formations, dispersions) rearrange matter and curvature *within* the slices Σ_T but do not redefine the global temporal direction U nor the foliation at leading order.

Operational anchor (cosmology). Choose U as the comoving congruence for which the cosmic microwave background (CMB) dipole vanishes – i.e., the large-scale energy flux is zero (Landau–Lifshitz frame) [4]. Then T agrees with standard cosmic time up to small peculiar-velocity and inhomogeneity effects. This is a *preferred temporal foliation (CMB–comoving)*, not a material ether or spatial rest medium.

GR compatibility (definition of U). Let $\bar{T}^{\mu\nu}(L)$ be the coarse-grained stress energy tensor obtained by averaging over a smoothing scale L exceeding the homogeneity scale. Define U^μ as the unit timelike eigenvector of $\bar{T}^\mu{}_\nu$ (energy frame) [5]. Assume *global hyperbolicity* and *small vorticity* on these scales (so U is hypersurface-orthogonal) and admits a foliation $\{\Sigma_T\}$. Backreaction from inhomogeneities is absorbed into $\bar{T}^{\mu\nu}$; the residual tilt δU from any compact subsystem of energy E_S is suppressed as

$$\|\delta U\| = O\left(\frac{E_S}{E_H}\right), \tag{25}$$

where E_H is the energy in a Hubble-scale domain.

What "undisturbed" means. "Undisturbed" does not mean absolutely immune; rather, it means *coarse-grained insensitivity*: local events produce only higher-order changes in U and $\{\Sigma_T\}$. Thus, the universal T–axis provides a stable global ordering, while all local dynamics (including strong interactions) proceed within the slices Σ_T.

Example: Milky Way–Andromeda merger

- *This framework:* The MW–M31 collision reconfigures mass distribution and local curvature, but the large-scale comoving congruence (CMB rest frame) and the foliation $\{\Sigma_T\}$ persist; any induced tilt in U is negligible on cosmological smoothing scales.
- *Standard cosmology:* Worldlines follow geodesics in an (approximately) FLRW background; the merger appears as two worldlines intersecting within block spacetime, with "cosmic time" defined by the comoving congruence [4].

Remark. This postulate is analogous in spirit to the Cosmological Principle [4]: it posits a statistically homogeneous and isotropic large-scale temporal structure against which local physics plays out.

Comparison with Lorentz Ether Theory

Shared Principles

Both Lorentz Ether Theory (LET) and the present framework (Universal Time & Tick Suppression) reject the notion that time is inherently relative [7]. They concur on the following foundational points:

- Absolute or universal time exists.
- Relativistic effects are real physical phenomena resulting from changes in systems, not illusions.
- Purely observer-based interpretations provide an incomplete description of physical reality.

Key Differences

Table 1: Distinctions between Lorentz Ether Theory (LET) and the present framework.

Aspect	**Lorentz Ether Theory (LET)**	**This Framework**
Ether	Postulates an undetectable material medium	No ether; *preferred temporal foliation (CMB–comoving)*
Preferred Frame	The rest frame of the ether	Preferred *temporal* foliation; no preferred *spatial* rest medium
Clock Slowing	Apparent effect due to motion through ether	Real physical effect: suppression of internal rates
Simultaneity	Absolute but empirically hidden	Absolute and ontologically fundamental
Geometry	No explicit modern spacetime framework	Geometric: universal time axis T defines the slicing $\{\Sigma_T\}$
Modern Compatibility	Operationally indistinguishable from SR	Operationally equivalent; adds a causal (mechanistic) interpretation of suppression

Notes. This framework posits a *preferred temporal foliation, not a material ether or spatial rest medium.* Predictions remain those of SR/GR in all tested regimes.

Addressing the Michelson–Morley Challenge

A significant challenge for any theory positing a universal time is explaining the null result of the Michelson–Morley experiment and its successors [6, 7].

This framework replaces the ether with a shared temporal structure: the universal T–axis. The central question becomes: *What is the physical mechanism for tick suppression in this model?* The proposed answer is that both velocity and gravity are manifestations of a deeper underlying cause: **deviation from co-motion with the T–axis** [10].

Rods as well as clocks. Because spatial metrology is built from the same suppressed processes as clocks, measured lengths parallel to motion contract by $1/\gamma$ in the T–gauge (matching SR, see also (21)). Together with synchronized rate suppression, this yields the Michelson–Morley null.

The Inertial Suppression Principle

This framework is grounded in the following physical mechanism:

1. **The Natural State.** An object's unsuppressed state is to be co-moving with the universal flow, defined by the cosmic flow field U ($U[T] = 1$). In this state, its four-velocity u^μ is aligned with U^μ, and its internal processes proceed at their maximum rate.

2. **The Cause of Suppression.** Any deviation from this state (kinematic or gravitational) tilts the system's four-velocity u^μ relative to the universal flow.

3. **The Effect.** This geometric tilt reduces the system's rate of proper-time accumulation. The total suppression factor $S \in (0, 1]$ is given by the reciprocal of the alignment factor α:

$$\gamma_{\mathrm{rel}} := -\, g_{\mu\nu} u^\mu n^\nu \;\geq\; 1, \quad \alpha := \gamma_{\mathrm{rel}}^{-1} \in (0, 1], \quad S(\gamma) = \alpha\, s_{\mathrm{tick}}(\gamma), \quad d\tau = S\, dT, \tag{26}$$

   where n^μ is the unit normal to the slices Σ_T (aligned with U on the hypersurface-orthogonal domain). A smaller projection ($S \downarrow$) means fewer ticks per unit universal time:

$$d\tau = S\, dT. \tag{27}$$

   Operationally, the system's internal processes run slower – this is **tick suppression**.

From Geometry to Mechanism: Reinterpreting the Metric

This interpretation does not discard General Relativity; it provides a physical reinterpretation of its mathematical structure. The standard formulation,

$$c^2\, d\tau^2 = g_{\mu\nu}\, dx^\mu dx^\nu, \tag{28}$$

is traditionally viewed as defining the geometry of spacetime [3]. In this framework, it is reinterpreted as a **measure of suppression** – a physical description of how a system's kinematic or gravitational state reduces its tick rate relative to universal time dT.

This gives the causal reformulation

$$d\tau = (\text{suppression factor}) \times dT, \tag{29}$$

with the familiar limits:

- **Kinematic suppression:** $S = \sqrt{1 - v^2/c^2}$ (cf. (11)), where v is the *physical* 3–velocity measured by Eulerian observers (the T–adapted orthonormal triad).
- **Gravitational suppression (static):** $S = \sqrt{-g_{00}}$ (cf. (13)); in the weak field with $\Phi < 0$, $S \approx \sqrt{1 + 2\Phi/c^2}$ (cf. (14)).

Explaining the Michelson–Morley Null Result

The Inertial Suppression Principle provides a clear explanation for the null result:

- The interferometer (rulers, mirrors, atoms) is a physical system subject to the same suppression law $d\tau = S\,dT$ (cf. (27)).
- Any attempt to detect absolute motion using material instruments fails because **all material processes are suppressed in concert**.
- Light propagation, being massless, remains unsuppressed ($d\tau = 0$, see (15)) and maintains speed c; but the synchronized suppression of clocks *and* rods (lengths contract by $1/\gamma$ parallel to motion in the T–gauge) cancels expected anisotropies, producing a null result.

This is not a conspiracy but a universal law: matter cannot detect its own motion relative to the T–axis with tools made of the same matter, because all are affected equally by the same suppression mechanism [12, 13].

Conclusion

Physics has long mistaken what clocks reveal. Clocks do not measure time itself; they measure the rate of their own internal processes. Because those processes are subject to suppression, clocks can and do under report the universal duration.

By contrast, light propagation is unsuppressible: it provides the invariant calibration of the universal time axis T. The great misstep has been to confuse suppressed tick counts with "time," creating the illusion that time itself dilates. What actually varies is the capacity of physical systems to convert the universal progression dT into their own ticks $d\tau$.

This paper has presented a framework that recasts relativistic phenomena not as geometric properties of "time itself" [1, 3], but as consequences of a single suppression law,

$$d\tau \;=\; S\,dT, \qquad S = \alpha(v,\Phi)\,s_{\text{tick}} \in (0,1], \tag{30}$$

with *ideal* clocks obeying $S = \alpha = \gamma_{\text{rel}}^{-1}$ (where $\gamma_{\text{rel}} = -u^{\mu}n_{\mu} \geq 1$, cf. (26)). In static gravitational fields the canonical factor is

$$S = \sqrt{-g_{00}}, \qquad \text{and in the weak field with } \Phi < 0: \quad S \approx \sqrt{1 + \tfrac{2\Phi}{c^2}}. \tag{31}$$

We call this the *Inertial Suppression Principle*:

> *Deviation from the universal time flow reduces the projection $d\tau/dT$, thereby suppressing internal process rates.*

This unifies kinematic and gravitational "time dilation" under a single causal description without altering SR/GR predictions.

The implications are fourfold:

1. **Universal temporal background.** Time is modeled as a physical, universal scalar field T supplying a preferred *temporal* foliation (CMB–comoving); this is *not* a material ether or spatial rest medium. The foliation provides an absolute ordering and a common yardstick for durations.

2. **Operational equivalence.** All standard tests are reproduced – muon lifetimes, Hafele–Keating, Pound–Rebka, GPS – since S matches the SR/GR factors in the relevant limits. The change is interpretive, not predictive. [17, 12, 13, 14, 15, 11]

3. **Mechanism over metaphor.** The slowdown of clocks and extension of lifetimes are attributed to a reduction in the projection factor $S = d\tau/dT$ (cf. (27)). Phrases like "energy allocation" are interpretive shortcuts for this projection; *no continuous work is required* to maintain inertial motion or a static position in a gravitational field [12, 13].

4. **Clearer ontology.** Frame-dependent descriptions are recovered as perspectives on a single T–ordered reality. The metric still encodes spacetime structure, but here it has a physical reading: it determines *how much* of the universal flow a system converts into its own ticks [5].

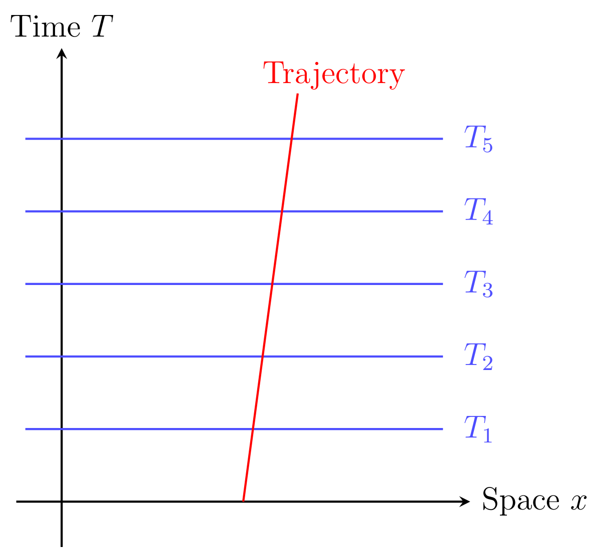
In short, standard relativistic effects can be *reinterpreted* as suppression of internal dynamics relative to a universal temporal flow, rather than as a change in the flow of time itself. This *Universal Time and Tick Suppression* viewpoint remains fully compatible with the empirical success of relativity while offering a causal, realist narrative for why moving clocks run slow and clocks in gravitational wells tick less.

Takeaway 1. Time flows universally; what varies is not time itself, but each system's capacity to manifest change within it.

$$\boxed{d\tau = S\,dT, \qquad S = \alpha(v,\Phi) = \gamma_{\rm rel}^{-1}, \qquad (\textit{ideal clock})} \tag{32}$$

A Global Structure of the T-Foliation

Local vs. Master Time. Each subsystem may use a local time label T_i, but on any domain admitting a universal time field T we require $T_i = a_iT + b_i$ (affine gauge). Physical ticks obey $d\tau = S\,dT$ with $S \in (0, 1]$. A global "Master" T exists when the foliation extends to all of $\mathcal{M}$; otherwise, we work with a foliation atlas $\{(\mathcal{U}_a, T_a)\}$ satisfying $T_a = \alpha_{ab}T_b + \beta_{ab}$ on overlaps.



Remark 6 (Calendar analogy). *The universal interval ΔT is like the change in date stamp (non-repeating, global order), while local labels $T_i = a_i T + b_i$ play the role of time zones/calendars. Physical ticks satisfy $d\tau = S\,dT$ (fewer ticks per unit T for $S < 1$), so clocks can disagree on elapsed ticks over the same date change, but not on the ordering supplied by T.*

B Glossary of Symbols

Symbol	**Description**	**Units**
T	The universal time coordinate.	s
dT	An infinitesimal increment of universal time.	s
Σ_T	A hypersurface of constant universal time T.	—[1]
U^μ	The 4-velocity of the cosmic flow field.	Dimensionless (or m/s)
n^μ	The unit vector field normal to the Σ_T slices.	Dimensionless
N	The lapse function in the 3+1 formalism.	Dimensionless
N^i	The shift vector in the 3+1 formalism.	m/s
h_{ij}	The 3D spatial metric on a Σ_T slice.	Dimensionless
S	The total suppression factor ($S = d\tau/dT$).	Dimensionless

[1] Denotes "Not Applicable," used for concepts that are not physical quantities with units.

Symbol	Description	Units
α	The relativistic conversion coefficient ($S = \alpha$ for ideal clocks).	Dimensionless
$d\tau$	An infinitesimal increment of proper time (duration).	s
γ_{rel}	The relativistic gamma (Lorentz) factor ($\alpha = 1/\gamma_{\text{rel}}$).	Dimensionless
v	Physical 3-velocity relative to Eulerian observers.	m/s
v_{pec}	Peculiar velocity relative to the CMB frame.	m/s
Φ	The Newtonian gravitational potential.	m^2/s^2
$g_{\mu\nu}$	The 4D spacetime metric tensor.	Dimensionless
$\mathcal{M}$	The 4D spacetime manifold.	—
MCIF	Momentarily Comoving Inertial Frame.	—
CMB	Cosmic Microwave Background.	—

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