A Temporal Continuum Hypothesis
Gravitation as a Boundary Condition Resultant

Essay written for the Gravity Research Foundation 2026 Awards for Essays on Gravitation

Abstract

The Temporal Continuum Hypothesis (TCH) models the Present as a three-sphere of energy potential—an electromagnetic-coupled Boundary Manifold omni-expanding at *c* into an absolute Temporal Void. Gravitation is recast as a boundary-condition resultant of a discrete, Planck-scale state-transition, establishing a generative Scalar Vacuum Tensor modulated by a Thermodynamic Differential. Gravitation and inertia emerge as metric impedances of the resulting spatial-temporal refresh rate. This generative baseline establishes simultaneity across the boundary horizon.

The TCH resolves the dark sector via cosmological vacuum tension and global inertial offsets, while accounting for Hubble tension via hyperspheric scaling. Relativistic singularities vanish as null volume acceleration replaces infinite geometric curvature. Galactic dynamics are reconciled without phenomenological placeholders or hypothetical particles. A unified, isentropic foundation for an inherently cyclic Universe is presented.

Introduction

The TCH defines the “Present" as a radiant three-sphere—a three-dimensional hypersphere—expanding into a “Temporal” vacuum potential. It distinguishes the measure of “time”, the perceived duration of spatial-temporal events, from the Temporal Void, a four-dimensional manifold providing the radial dimension into which the three-sphere expands. The positive Present energy potential and the negative Temporal vacuum potential are mutually exclusive. Such fundamental exclusivity generates the Thermodynamic Differential compelling the hypersphere to expand.

Gravity and inertia emerge from this tension, not as primordial properties, but as Boundary-Condition Resultants. Advancing the Present expansion is the cosmological action of the inertial Future. The action of the Past, by which the Present is vacuum tensioned, is gravitational. These symmetrically opposed vacancies of Past and Future, however, are really one and the same undifferentiated Temporal continuum. Their actions appear proportionally opposed because the cosmological Future presents globally while the gravitational Past is present everywhere locally.

Section I: The Scalar Vacuum Tensor at the Entropic Horizon

To quantify the generative instant when the expanding Present three-sphere encounters the four-dimensional Temporal Void, we must define the boundary condition where this expansion occurs. This boundary, an entropic horizon, is not a spatial edge, but rather the leading frontier of state-transition occurring at c.

1. The Thermodynamic Differential

The Present expansion is actuated by the Thermodynamic Differential ($\Delta\Theta$): the fundamental exclusivity of the positive energy (ρ_E) and the negative vacuum (ρ_V). As macroscopic systems naturally evolve to resolve absolute gradients and maximize entropy, the three-sphere boundary condition is compelled to expand. We can define this Thermodynamic Differential:

$$\Delta\Theta = \rho_{\mathrm{E}} + \rho_{\mathrm{V}}$$

2. The Scalar Vacuum Tensor

To mediate the moment the Present encounters its Temporal counterpart, we introduce the Scalar Vacuum Tensor ($\hat{\mathrm{Y}}$). Note that the Temporal fourth dimension is an absolute absence; any geometric structure is a mathematical overlay. Therefore, $\hat{\mathrm{Y}}$ is not a geometric function, but a generative thermodynamic operator establishing the rate of spatial-temporal emergence at the entropic horizon.

It establishes the local metric as a consequence of the state-transition, allowing metric calculations to continue on the surface of the expanding Present. Acting upon the Boundary Manifold ($\partial\Omega$) of the three-sphere, the tensor is expressed as an integral over the local state-transition surface:

$$\hat{Y} = \oint \partial\Omega \, (\Delta\Theta \cdot \varphi_t) \, d^3x$$

Where $\Delta\Theta$ is the Thermodynamic Differential and φ_t is the Temporal Permeability Constant, defined as $\varphi_t = G/c^2$. This constant represents the inverse-action resistance of the Temporal Void to the expansion of the Present three-sphere. Setting φ_t to this ratio achieves the dimensional units of volume acceleration (m^3/s^2), quantifying the precise rate of spatial-temporal emergence across the Boundary Manifold. d^3x is the differential volume element of this manifold.

3. The Emergence of Gravitation and Inertia

When $\hat{Y}$ operates on a region of high energy density—mass—the metric impedance increases, thereby impeding the resolution of the Thermodynamic Differential. This interaction, mediated by Temporal Permeability, reduces the local spatial-temporal refresh rate. Gravitation thus emerges as a localized reduction in volume acceleration. This does not change the dynamics of a preexisting space; it is a drag on the very emergence of the metric itself. Gravity is the vacuum tension of the Past dragging on all the localized centers-of-mass in the Present.

Conversely, the "moment" of inertia emerges as the global resultant of this tension, the suction of the Future vacuum potential acting to maintain the Present metric state. Although the inertial Future and gravitational Past are dynamically converse, there's only one Temporal vacuum potential, so their resultants are equivalent: the causal basis of Newton's first and third laws, Einstein's "equivalence principle", and the centripetal and centrifugal "pseudo" forces.

Section II: Thermodynamic Reconciliation of the Dark Sector

The current standard cosmological model relies on phenomenological placeholders such as “dark energy” and “dark matter” to balance the observed mechanics of the Universe. The TCH proposes these dark phenomena are not due to missing extrinsic components, but rather are macroscopic thermodynamic resultants.

1. Dark Energy as Cosmological Vacuum Tension

In contemporary cosmology, dark energy is posited as a hypothetical negative pressure causing an apparent accelerated expansion of the Universe. Within the TCH framework this negative pressure is the Thermodynamic Differential between the positive density of the Present and the absolute vacancy of the Temporal Void. The cosmological constant (Λ) is therefore recast not as an intrinsic energy of space, but as the macroscopic expression of the vacuum suction of the Temporal potential. The apparent acceleration of the Present expansion is the metric result of the hypersphere’s increasing surface area; as the Boundary Manifold expands, the total interaction area with the Temporal Void increases, proportionally scaling the rate of spatial-temporal generation.

2. Dark Matter as Global Inertial Offset

The TCH defines dark matter as a Global Inertial Offset. As established, gravitation is the local drag of the Past vacuum impeding the expansion of the Present, while inertia is the non-local, global suction of the Future vacuum. Every localized center-of-mass creates a metric impedance opposed by its global counterpart. Therefore, the “missing mass” implicated in galactic dynamics is actually a misidentified systemic requirement. It is the macroscopic expression of the global inertial baseline compensating for the aggregated local gravitational impedance across the entire expanding boundary condition.

Section III: Time's Apparent "Arrow" and Theoretical Reversibility

1. The Thermodynamic Arrow

In the TCH framework, the unidirectional "arrow of time" is the macroscopic expansion of the radiant Present into the four-dimensional Temporal Void, modulated by the Thermodynamic Differential. Because the Scalar Vacuum Tensor acts to resolve absolute gradients, the Present expansion is an inherently one-way, entropic process.

2. Entropic Reversibility

The TCH supports two-way Temporal reversibility in terms of a macroscopic isentropic cycle. Within the Temporal continuum Past and Future are not coordinates or independent histories, but rather reciprocal thermodynamic distinctions. Therefore, once $\Delta\Theta$ is fully resolved at maximum expansion, the state-transition initiates a universal phase shift, precipitating an inevitable return to the Universal Origin.

3. The Null interval and Kinematic Time Dilation

The TCH recasts standard relativity's null invariant interval at c as the geometric baseline for absolute simultaneity across the expanding Boundary Manifold $\partial\Omega$. Because the three-sphere expands radially into the Temporal Void at c, the horizon itself represents this universal null condition. Consequently, any mass translating across $\partial\Omega$ necessarily diverts a portion of its total velocity vector from radial temporal expansion into spatial velocity. Velocity time dilation is thus the empirical prerequisite of a boundary condition evolving at c.

Section IV: Empirical Alignments and Testable Predictions

1. Resolving the Hubble Tension

Discrepancies in H_0 measurements are an expected result of the scaling Boundary Manifold. Because $\hat{Y}$ operates on the total surface area, the generation rate is higher in the late universe than in the baseline established during the early universe. Specifically, the rate scales proportionally with the hyperspheric volume, $2\pi^2r^3$: a divergence that naturally separates late universe H_0 values from the early-universe baseline.

2. Gravitational Lensing as Metric Refraction

Cosmic light deflection is recast as a variable refractive index of the Present. As electromagnetic radiation traverses regions of lower Temporal Permeability on the Boundary Manifold, the local metric impedance acts as a cosmic lens, refracting the wavefront toward the mass. We are residents of the Present, looking out across the star-studded galactic surface of a continuous hypersphere, a luminous, vanishing expanse stretching to infinity.

3. Mass Centroids and Temporal Refresh Stalls

Newton's "point" centers of mass and Einstein's "field singularities" are recast as Temporal Refresh Stalls. As permeability $\varphi_t \to 0$ near mass centroids, the state-transition halts, resolving singularities into regions of metric stasis rather than infinite geometric curvature. The TCH identifies the cosmological Universal Origin not as a mathematical singularity, but as an absolute temporal refresh stall—the zero-state of the Scalar Vacuum Tensor.

4. Prediction: Anomalous Velocity in Cosmic Voids

In extreme cosmic voids where $\rho_E \approx 0$, the local drag of the Past is at its minimum. The TCH predicts anomalous velocity dispersions in these regions, where matter motion exceeds General Relativity's expectations due to the nearly unopposed vacuum potential of the Future.

5. Prediction: Redshift Quantization

If spatial-temporal generation is a state-transition, expansion may occur in “generative pulses”. This implies a subtle quantization of redshift in distant galactic clusters, representing discrete metric sampling at the Planck scale.

Section V: The Eternal Cycle and the Universal Origin

The evolution of the Universe is the active resolution of the thermodynamic gradient $\Delta\Theta$. As the Present hypersphere expands into the Temporal Void, its positive energy density ρ_E is distributed across a growing volume until it asymptotically approaches zero.

At absolute equilibrium ($\Delta\Theta = 0$), the Scalar Vacuum Tensor reaches a null state ($\hat{Y} \to 0$) and the expansion halts. Without the Future vacuum suction to sustain the global inertial baseline, the gravitational potential of the Past dominates and the Boundary Manifold’s metric integrity collapses. This induces a universal phase shift—the cyclic return to a Universal Origin.