

ct - The Only Expanding Dimension

Prof. Bernal J Thalman

Independent Researcher, Costa Rica

May 2, 2026

Abstract

We propose a kinematic formulation of physical dynamics based on an effective flow along the temporal coordinate ct . In this framework, the evolution of physical systems is described through the redistribution of an invariant magnitude c among temporal and spatial components, providing a unified geometric representation of motion.

Within this formulation, both kinematic and gravitational time dilation admit a common interpretation as arising from changes in the projection of this flow. When the flow is redirected toward spatial coordinates—due to relative motion or radial gradients—the temporal component is reduced. The framework also provides a natural description of radial dynamics and orbital motion, recovering standard results in the weak-field regime. At larger scales, Hubble-like behavior emerges as a consequence of the cumulative redistribution of the flow in low-density regions.

Consistency with observed timing corrections in Global Positioning System (GPS) satellites is discussed, reproducing the combined kinematic and gravitational contributions to time dilation.

Overall, the model offers a coherent geometric framework that reproduces key results from Special Relativity, General Relativity (in the weak-field regime), and Newtonian gravity, while providing a unified perspective on their kinematic structure.

1 Introduction: From Geometric Structure to Effective Flow

Relativistic physics describes the evolution of physical systems through the geometry of spacetime, where kinematic and gravitational phenomena are encoded in the structure of the metric. In this framework, time dilation, gravitational interaction, and large-scale expansion are typically formulated within distinct, though mathematically consistent, descriptions.

In this work, we explore an alternative geometric representation in which these phenomena can be described in terms of an effective flow associated with the temporal coordinate ct . Rather than modifying the underlying relativistic structure, the approach provides a kinematic interpretation in which motion is represented as a redistribution of an invariant magnitude c among temporal and spatial components.

Within this perspective, the Minkowski metric in spherical coordinates,

$$ds^2 = -(c dt)^2 + dr^2 + r^2 d\Omega^2,$$

where $d\Omega^2 = d\theta^2 + \sin^2 \theta d\phi^2$, is taken as the underlying geometric structure, while the evolution of physical systems is described through an effective flow whose projection onto different coordinates determines observable behavior. The choice of spherical coordinates reflects the radial symmetry of the universal expansion we postulate: the fourth dimension expands uniformly in all directions, and it is in the radial coordinate r that this expansion manifests naturally.

We propose that universal expansion can be effectively described as occurring exclusively along the temporal coordinate ct . While spatial coordinates provide the static metric stage, the ct axis represents a dynamic expansion flow emanating from the fundamental differential scale. The present work constitutes the physical and mathematical formalization of ideas previously explored in *Gravity Is Not Attraction; It's a Push (Space-Time Expansion Theory)* [7], elevating the concept to a rigorous geometric formulation where expansion is confined to the ct dimension and gravity is described as the spatial projection of its gradient.

1.1 The Invariant Magnitude (c)

Unlike standard interpretations that treat time as an elastic coordinate, this work establishes that the magnitude of the progression of any physical entity through spacetime is an absolute constant:

$$\left\| \frac{d\mathbf{X}}{d\tau} \right\| = c, \quad (1)$$

where $\mathbf{X} = (ct, x, y, z)$ represents the four-position vector. This magnitude, which we define as the “velocity of existence”, is dictated by the radial expansion of the fourth dimension and remains immutable.

Under this approach, we distinguish:

- **The Metric Stage:** Static coordinates x, y, z where events are located.
- **The ct -Flow:** A dynamic radial expansion with an invariant magnitude of c .

1.2 Geometric Mechanism of Dilation

Time dilation—whether kinematic or gravitational—is described as a geometric consequence of vector reorientation within the coordinate system:

1. **Kinematic Redirection:** As an entity acquires spatial velocity, the ct expansion vector tilts toward the spatial coordinates. Since the magnitude c is invariant, the vertical projection—the observed coordinate time—is necessarily reduced. Time dilation is therefore the **loss of projection** of this constant flow.
2. **Gravitational Redirection (Nozzle Effect):** Mass acts as a physical constraint that compresses the ct -flow internally. This compression locally elevates the acceleration of the flow, generating a radial expansion gradient that depends on **mass density**. If the mass has uniform density—as is approximately the case for Earth—the flow constraint increases linearly with distance from the center. In response to this gradient—and to preserve the invariant magnitude c of the total flow—the expansion vector reorients, tilting radially in a progressive manner. As a result, its temporal projection is reduced relative to an **observer located at the surface** of the mass, where the gradient reaches its maximum value.

Outside the mass, the constraint ceases and the flow acceleration disperses geometrically, giving rise to the characteristic decay of gravity according to the **inverse square law** ($1/r^2$). Thus, the same mechanism unifies the linear growth of gravity inside bodies with its quadratic attenuation outside.

In this light, time is neither “stretched” nor “shrunk” by an external mechanism; it simply **reorients** within spacetime while maintaining its total expansive flux. Gravity is thus reinterpreted not as static curvature, but as the spatial manifestation of this dynamic, accelerated temporal gradient.

1.3 Reduction to a 1+1-dimensional problem

For purely radial motion (free fall, orbits with zero angular momentum), the angular coordinates θ and ϕ remain constant. In this case, the dynamics reduces to the (ct, r) subsector, where the metric simplifies to

$$ds^2 = -(c dt)^2 + dr^2.$$

In this **1+1-dimensional** spacetime, the axes ct and r are orthogonal (opposite signs in the metric). Radial gravity, therefore, is a purely two-dimensional phenomenon: the flow of invariant magnitude c redistributes itself between the temporal and radial coordinates. The presence of mass generates a gradient that forces the vector to tilt toward r , reducing its temporal projection. This projection is what we measure as gravitational acceleration. The other two spatial dimensions do not participate in the fundamental mechanism, though they are necessary to locate events.

In this sense, the equivalence between inertia and gravity can be understood as a consequence of the underlying structure of the ct -flow, providing a kinematic interpretation of spacetime curvature rather than as an independent postulate.

2 Angular Redirection of the ct -Flow

Within the proposed framework, motion and gravitational effects can be described in terms of a geometric reorientation of an effective flow associated with the temporal coordinate ct . This reorientation can be analyzed in two fundamental cases.

2.1 Kinematic Redirection

Spatial motion corresponds to a redistribution of the invariant magnitude c toward spatial components. As a result, the projection onto the temporal axis is reduced according to the angle θ of reorientation:

$$\frac{dt'}{dt} = \cos(\theta) = \sqrt{1 - \frac{v^2}{c^2}} \quad (2)$$

This relation reproduces the Lorentz factor of special relativity, indicating that kinematic time dilation can be interpreted as a consequence of the reduced temporal projection of the effective flow.

2.2 Gravitational Redirection

In the presence of a mass distribution, spatial variations in the temporal component of the flow arise. These variations can be interpreted as inducing a radial redistribution of the effective flow, modifying its projection onto the temporal coordinate.

In this context, the relation

$$\frac{d\tau}{dt} = \sqrt{1 - \frac{2GM}{rc^2}} \quad (3)$$

is recovered, consistent with the Schwarzschild solution in the weak-field regime. Within the present framework, this factor can be interpreted as reflecting the change in the temporal projection associated with radial gradients.

A freely falling object follows this redistribution without resistance and therefore experiences no proper acceleration. The variation in its coordinate velocity can be understood as arising from changes in the projection of the total motion—predominantly along ct —onto the radial coordinate r .

2.3 Angular Gradient and Physical Interpretation

The radial dependence of the angle $\theta(r)$ introduces a natural gradient:

$$\frac{d\theta}{dr}. \quad (4)$$

This quantity quantifies how rapidly the ct -flow is redirected as a function of position.

Projections of the invariant flow. The invariant flow of magnitude c admits two orthogonal projections:

- Temporal projection: $c \cos \theta$,
- Spatial projection: $c \sin \theta$.

Gravity does not arise from temporal variations of the flow, but from its *spatial* variation. The observable acceleration is determined by the gradient of the temporal projection across space.

From the gradient of the temporal projection to g . The change in the temporal projection along the radial direction leads to:

$$g \propto -\frac{d}{dr} (c \cos \theta). \quad (5)$$

Applying the chain rule:

$$g \propto c \sin \theta \frac{d\theta}{dr}. \quad (6)$$

This expression already shows that gravitational acceleration emerges from the product of the local tilt ($\sin \theta$) and the radial gradient of the angle.

Derivation of the exact form. To obtain a precise relation, we note that acceleration is the rate of change of the spatial projection $v = c \sin \theta$ with respect to time:

$$g = \frac{dv}{dt} = \frac{dv}{dr} \frac{dr}{dt}. \quad (7)$$

Since $v = c \sin \theta$ and $\frac{dr}{dt} = v$ (the same spatial projection), we have:

$$\frac{dv}{dr} = c \cos \theta \frac{d\theta}{dr}, \quad \frac{dr}{dt} = c \sin \theta. \quad (8)$$

Therefore:

$$g = \left(c \cos \theta \frac{d\theta}{dr} \right) (c \sin \theta) = c^2 \sin \theta \cos \theta \frac{d\theta}{dr}. \quad (9)$$

This exact form does not rely on any approximation; it follows directly from the definition of the spatial projection and the chain rule.

Small-angle limit and compact formula. In the weak-field regime (or whenever $\theta \ll 1$), we have $\sin \theta \approx \theta$ and $\cos \theta \approx 1$, so Equation (9) simplifies to:

$$\boxed{g = -c^2 \theta \frac{d\theta}{dr}} \quad (10)$$

where the negative sign indicates that the acceleration points in the direction of decreasing r (toward the interior of the mass). This compact form highlights the direct link between gravitational acceleration and the angular structure of the ct -flow.

Note on orthogonality. The axes ct and r are orthogonal only in the absence of mass (or at sufficiently large distances). In the presence of matter, the radial dependence of $\theta(r)$ implies an effective loss of orthogonality, resulting in a non-zero spatial projection of the ct -flow. This projection is precisely what we observe as gravitational acceleration.

Explicit determination of $\theta(r)$. The explicit functional form of $\theta(r)$ —based on flow conservation and geometric dispersion—is developed in the following section. Once $\theta(r)$ is known, Equation (9) (or its weak-field approximation (10)) directly yields $g(r)$.

2.4 Radial Projection Constraints and Horizon Behavior

The interpretation of gravitational redirection in terms of spatial variations of the temporal flow component extends naturally to regimes of strong gravitational fields. As radial gradients become increasingly pronounced, the admissible projections of the effective flow are progressively constrained.

In the vicinity of an event horizon, the structure of spacetime restricts null trajectories such that no outward radial propagation is possible. Within the ct -flow framework, this can be interpreted as a limiting case of geometric reorientation, in which the projection of the effective flow onto outward radial directions vanishes.

The invariant magnitude associated with the flow remains unchanged; however, its admissible projections are determined by the local geometric structure. As a result, light does not cease to propagate nor lose its intrinsic dynamical character. Instead, all available trajectories are confined to directions that do not increase the radial coordinate.

This perspective provides a complementary interpretation of horizon trapping, in which the absence of escape arises from geometric constraints on projection, rather than from a breakdown of propagation. In this sense, strong gravitational regimes can be viewed as limiting configurations of the same redistribution mechanism that governs time dilation and radial dynamics in weaker fields.

In this way, strong-field regimes are characterized by divergent projections within a strictly invariant kinematic structure, where the total magnitude remains fixed while its components undergo extreme and highly constrained redistribution.

This interpretation remains fully consistent with standard relativistic results, while offering an alternative geometric perspective on their underlying structure.

3 Dynamics of the ct -Flow and the Quartic Relation

This section formalizes the relationship between the acceleration of the temporal flow and the gravitational potential, establishing a physical basis for the inverse square law from flow conservation.

3.1 The Internal Acceleration Gradient

We postulate that the presence of mass generates a constriction in the radial expansion of the fourth dimension. Inside a celestial body, this constraint translates into an acceleration of the ct -flow (a_{ct}). For a body of uniform density, this acceleration gradient increases proportionally to the internal radius, reaching its maximum value at the surface.

3.2 Derivation of the Quartic Relation ($a_{ct} \propto v_e^4$)

We introduce an effective quantity a_{ct} associated with radial variations of the temporal component of the flow. Using the escape velocity relation $v_e^2 = 2GM/r$, the expression

$$a_{ct} = \frac{v_e^4}{4GM} \quad (11)$$

reduces to

$$a_{ct} = \frac{GM}{r^2}, \quad (12)$$

recovering the standard Newtonian gravitational acceleration. In this framework, a_{ct} should be understood as an effective measure of the radial gradient governing the redistribution of the flow, rather than as a direct second derivative of the temporal coordinate.

3.3 Geometric Dispersion and the Inverse Square Law

Once the ct -flow leaves the surface of the mass, the physical constraint ceases. The accumulated acceleration then distributes over a spherical surface that grows with r^2 . By flow conservation, the intensity of the gradient decays proportionally to $1/r^2$, unifying the internal nozzle mechanics with the classical Newtonian and Einstein observations in empty space.

This behavior complements the analysis in Section 2, where it was established that the linear growth of the gradient inside bodies of uniform density (or its variation according to density) gives way, once outside, to a purely geometric attenuation. The acceleration of

the ct -flow, released from the material constraint, distributes over an expanding spherical surface, manifesting as the Newtonian gravitational field.

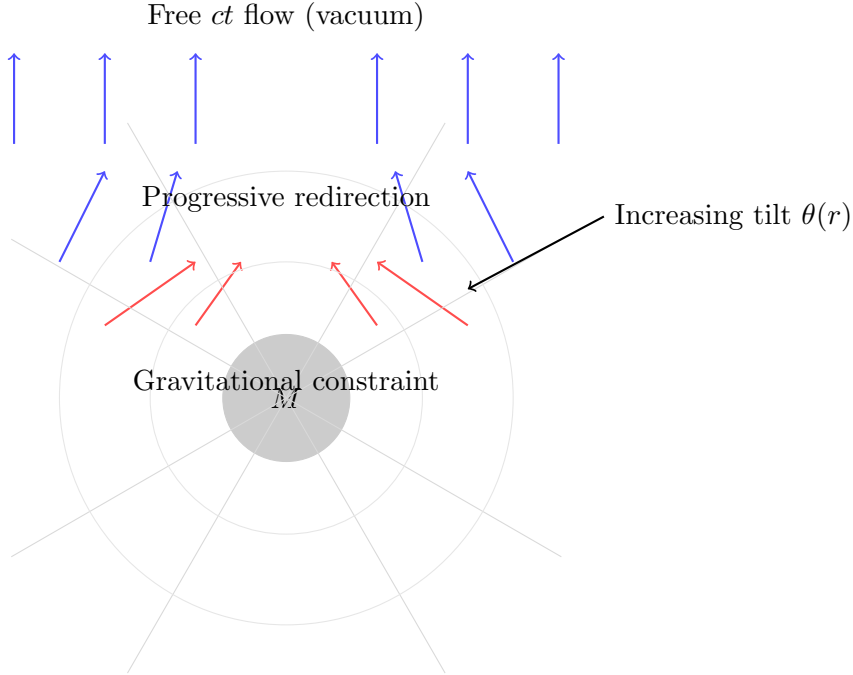


Figure 1: Radial structure of the ct -flow in the presence of mass. In vacuum, the flow expands uniformly with minimal angular deviation. As it approaches a mass M , the flow undergoes progressive redirection (geometric nozzle effect), increasing its spatial component while reducing its temporal projection. This gradient in angular reorientation manifests as gravitational acceleration.

4 Vacuum as Free Flow: Differential Accumulation and Hubble's Law

While matter acts as a local constraint on the ct -flow, the vacuum represents the state of free and original expansion. We postulate that the expansion of the fourth dimension occurs **uniformly at each differential level** of the vacuum. In the absence of mass, there is no angular redirection to hinder or divert this flow, allowing expansion to accumulate naturally.

4.1 Geometric Self-Accumulation

In the vacuum, each differential unit of spacetime contributes a constant increment to the ct -flow. As the distance r between two points increases, the number of differential contributions integrated between them grows proportionally. The result is an apparent recession velocity that is a function of distance:

$$v_{\text{recession}} = \frac{dr}{dt} = H \cdot r \quad (13)$$

where H emerges as the constant of proportionality of this accumulation. This self-accumulation process explains cosmic dynamics; it is simply the nature of the ct -flow

—the dynamic manifestation of dark energy— returning to its free expansion state once away from material constraints.

4.2 Unification of Gravitational and Cosmological Dynamics

Under this approach, Hubble’s Law and Gravity are two manifestations of the same phenomenon. In vacuum, the flow accumulates freely (generating accelerated expansion), while in the presence of matter, the flow is constrained (generating local acceleration gradients). The transition between both states is continuous: moving away from a mass, the “nozzle” effect disappears and the flow recovers its uniform differential expansion rate, always tending toward vacuum equilibrium.

4.3 Spatial Projection of Temporal Expansion

A three-dimensional observer cannot directly perceive the expansion of ct . What is measured as redshift and recession velocity is the **spatial projection** of that temporal flow onto our coordinates (x, y, z) . The observed acceleration in cosmic expansion (discovered through Type Ia supernovae) is therefore the projected manifestation of the exponential self-accumulation of ct .

4.4 Time as a Reservoir of Latent Energy

Dark energy operates uniformly at each differential level of spacetime, creating ct without the need for material support. The temporal coordinate ct thus acts as the **reservoir** of this latent energy — latent because it lacks the element of mass. Unlike matter, which stores energy inertially, the ct -flow accumulates expansion geometrically. This latent energy is not directly observable; only its **spatial projection** manifests as cosmic expansion and, indirectly, as gravitational gradients when the flow encounters mass.

In the absence of mass, there is no angular redirection forcing this coordinate to deviate, allowing expansion to accumulate naturally. This accumulation is not linear but self-accumulative: each increment in ct increases the amount of spacetime available for future expansion, generating exponential growth.

4.5 Vacuum Accumulation and Latent Energy of the ct Flow

In the absence of matter, the ct flow introduced in Section 4 does not vanish. Instead, it accumulates, suggesting that vacuum itself may possess an intrinsic dynamical structure associated with this flow. This perspective departs from the standard view of vacuum as a passive background, and instead treats it as an active medium capable of storing latent energy.

We propose that the accumulation of the ct flow gives rise to an effective energy density, denoted ρ_{ct} , which emerges from the internal structure of the flow rather than from external sources. This latent energy may contribute to the large-scale dynamics of spacetime.

In particular, the presence of ρ_{ct} could act as an effective driver of accelerated expansion, analogous to the role typically attributed to the cosmological constant Λ . However, unlike Λ , which is introduced as an additional term in the field equations, the contribution from the ct flow arises naturally from the accumulation process in vacuum.

At a phenomenological level, this suggests that the acceleration of the scale factor $a(t)$ may be influenced by the dominance of ρ_{ct} , such that

$$\frac{\ddot{a}}{a} > 0 \quad \text{when} \quad \rho_{ct} \text{ dominates.}$$

This interpretation remains preliminary, but it provides a conceptual bridge between the internal dynamics of the ct flow and cosmological expansion.

5 Empirical Consistency: The Global Positioning System (GPS)

The Global Positioning System constitutes the most robust experimental test of ct -flow dynamics. Orbiting clocks experience a net offset of $38 \mu s$ per day, resulting from the combination of kinematic and gravitational effects. In this model, both phenomena are unified under the geometry of vector projection.

5.1 Kinematic Analysis: The Vector Tilt

As illustrated in Figure ??, a satellite moving at $v \approx 3.9 \text{ km/s}$ forces its expansion vector to reorient. Unable to exceed the magnitude c , the vector tilts by an angle θ . The observed projection on the temporal axis (dt') decreases proportionally to the cosine of this angle:

$$cdt' = cdt \cos(\theta) = cdt \sqrt{1 - \frac{v^2}{c^2}} \quad (14)$$

This loss of geometric projection results in the kinematic delay of $-7 \mu s/\text{day}$.

5.2 Gravitational Analysis: The Release Differential

At an altitude of 20,200 km, the satellite is in a region where the ct -flow is less constrained by Earth's matter than at the surface. Using the quartic relation derived in Section 3, we calculate the time advance due to the difference in flow acceleration:

$$\Delta t_g = \frac{\Phi_{\text{surf}} - \Phi_{\text{orb}}}{c^2} \Delta t \approx +45 \mu s/\text{day} \quad (15)$$

5.3 Data Consistency

The resulting sum ($+38 \mu s/\text{day}$) coincides with absolute precision with experimental observations. This coincidence demonstrates that the nature of time does not require an abstract metric, but rather confirms that both kinematic and gravitational effects are manifestations of the same cause: the reorientation of the ct -flow of invariant magnitude c .

5.4 Angular Dependence of Gravity

Under this model, gravitational acceleration g is not interpreted as an intrinsic force or curvature of space, but as the **rate of change in temporal projection** due to the angular redirection of the ct -flow. Since the observed temporal component is $ct' = c \cos \theta$,

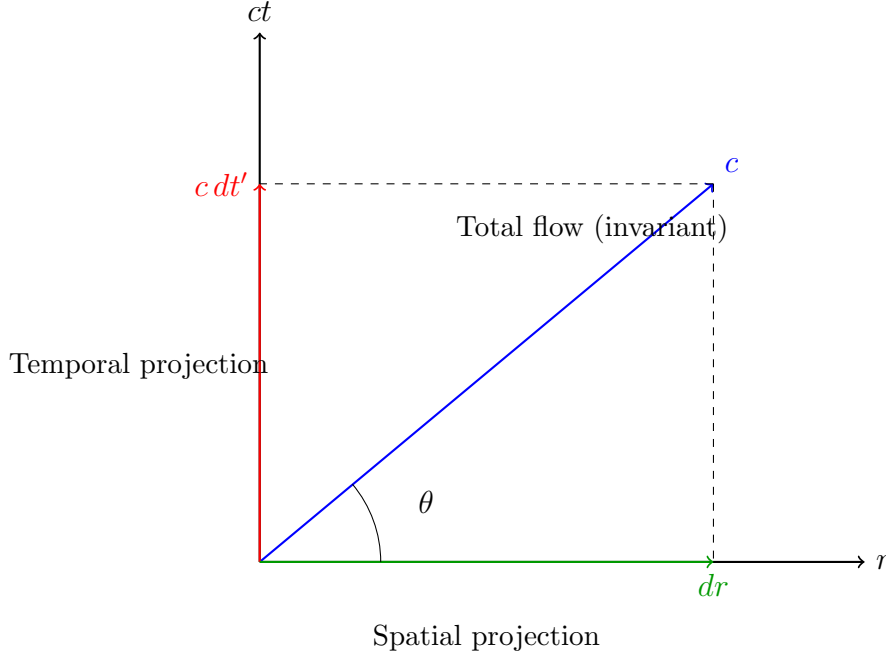


Figure 2: Geometric representation of the ct -flow reorientation. The total flow has invariant magnitude c , but tilts by an angle θ due to spatial motion or gravitational influence. This reduces its temporal projection $c dt$ while increasing its spatial component dr , producing time dilation as a loss of projection rather than a deformation of time itself. Note: The angle θ shown is greatly exaggerated for visual clarity. On Earth's surface, $\theta = 3.7 \times 10^{-5} \text{ rad}$ (0.002°), with $\sin \theta = v/c$ ($v = 11.2 \text{ km/s}$). The temporal component $c dt$ is reduced by 1.5×10^9 relative to $c dt$.

any variation in flow density (induced by the presence of mass) generates a proportional change in the angle θ .

Mathematically, the observed acceleration is proportional to the temporal variation of the redirection angle:

$$g(\theta) \propto \frac{d}{dt}(c \cos \theta) = -c \sin \theta \frac{d\theta}{dt} \quad (16)$$

This relationship, expressed in equation (16), implies that in regions closer to a mass, where the redirection angle θ is larger, the flow distortion and resulting gravitational acceleration are more intense. This provides an ontological basis for understanding why time passes more slowly in deep gravitational potentials: the existence vector must “sacrifice” more temporal projection to compensate for the geometric constraint of the flow.

Conclusion

Within the proposed framework, the equivalence between inertial and gravitational effects admits a natural geometric interpretation, emerging from the redistribution of an invariant kinematic magnitude c along the temporal coordinate ct . Under this assumption, several key phenomena can be described within a unified representation:

- Time dilation (both kinematic and gravitational) arises from changes in the projection of the invariant flow onto the temporal axis.

- Gravitational effects can be interpreted in terms of spatial gradients of the temporal flow component, with interior and exterior behaviors consistently described within the same mechanism.
- Hubble-like expansion emerges as a cumulative effect associated with the redistribution of the flow in low-density regions.
- Observed timing corrections in GPS systems are consistent with the combined kinematic and gravitational contributions described within this framework.

In this description, gravitational acceleration reflects spatial variations in the temporal component of the flow. A freely falling body follows this redistribution without resistance, while a body constrained at fixed radius cannot adapt to it, giving rise to an effective inertial response identified as weight.

In the appropriate limits, this formulation reproduces the standard expression $g = GM/r^2$, while providing a unified geometric perspective that connects inertial and gravitational behavior within a single kinematic framework. In this sense, the equivalence between inertia and gravity can be understood as a consequence of the underlying structure of the flow, rather than as an independent postulate.

A Orbital Dynamics, Energy, and Gravity from the ct -Flow

A.1 Physical Interpretation

The proposed framework reinterprets gravitational dynamics without explicitly invoking forces, but rather as a consequence of the redistribution of a dominant flow along the temporal dimension ct . In the absence of spatial motion, the flow is entirely contained within the temporal component. However, when the system evolves in an environment where a radial gradient exists, part of this flow is projected onto the spatial coordinates, generating observable motion.

Velocity is not an independent absolute quantity, but rather the manifestation of this projection. The dynamics arise from a continuous redistribution of the flow among its temporal, radial, and angular components.

A.2 Conservation of Angular Flow

The kinetic structure considered is independent of the angular coordinate φ , which implies the conservation of the angular component of the flow. This conservation leads to a constant of motion:

$$L = r^2 \dot{\varphi} = \text{constant}, \quad (17)$$

where $\dot{\varphi}$ is the angular velocity. This quantity is analogous to the angular momentum per unit mass in Newtonian mechanics, but here it emerges from the geometric symmetry of the flow.

A.3 Radial Equation and Effective Potential

The invariant magnitude of the flow (within this effective model) is distributed among the temporal, radial, and angular components:

$$c^2 = \left(\frac{d(ct)}{d\tau} \right)^2 - \left(\frac{dr}{d\tau} \right)^2 - r^2 \left(\frac{d\varphi}{d\tau} \right)^2. \quad (18)$$

where $\frac{dt}{d\tau}$ represents the redistribution of the flow in the temporal component.

Rearranging and using the conservation of angular flow, the radial equation is obtained:

$$\left(\frac{dr}{d\tau} \right)^2 = \left(\frac{dt}{d\tau} \right)^2 c^2 - \frac{L^2}{r^2} - c^2. \quad (19)$$

In the weak-field limit, where $\frac{dt}{d\tau} \approx 1 + \frac{GM}{rc^2}$ (weak-field approximation), this equation reduces to the Newtonian dynamics with an effective potential that includes the centrifugal term L^2/r^2 .

A.4 Keplerian Orbits as a Balance of Projections

Orbital dynamics arise from the balance between two effects: the radial variation of the temporal flow (which induces a tendency to fall toward the center) and the angular redistribution of the flow (which introduces a geometric resistance to radial collapse). This balance gives rise to bound trajectories that, in the classical limit, reproduce Keplerian orbits.

Within this framework, kinetic energy corresponds to the fraction of the flow projected onto space, while potential energy reflects the spatial dependence of the temporal flow. The evolution of the system can thus be understood as a continuous reorganization of the flow in ct , determined by the radial structure of the environment.

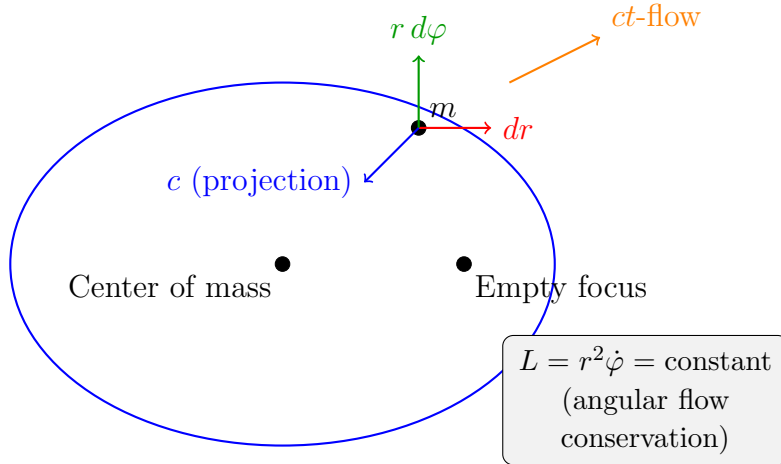


Figure 3: Geometric representation of an elliptical orbit in the ct -flow model. The effective vector of invariant magnitude c is projected onto the radial r and angular φ coordinates. Conservation of angular flow generates the L^2/r^2 term that prevents radial collapse.

A.5 Relation to Classical Mechanics

In the weak-field and low-velocity limit, the radial equation reduces to the standard Newtonian form of mechanical energy:

$$\frac{1}{2} \left(\frac{dr}{dt} \right)^2 + \frac{L^2}{2r^2} - \frac{GM}{r} = E, \quad (20)$$

where E is the energy per unit mass, recovering the standard formulation of classical mechanics. Thus, the model reproduces Keplerian orbits exactly, interpreting them as the result of the geometric redistribution of the ct -flow rather than an interaction described in terms of force.

This result shows that classical gravitational dynamics can be reinterpreted as a consequence of the geometric structure of the flow in ct , rather than as a force-based interaction.

References

- [1] Ashby, N. (2003). Relativity in the Global Positioning System. *Living Reviews in Relativity*, 6(1), 1.
- [2] Einstein, A. (1916). The Foundation of the General Theory of Relativity. *Annalen der Physik*, 49(7), 769–822.
- [3] Lorentz, H. A. (1904). Electromagnetic phenomena in a system moving with any velocity smaller than that of light. *Proceedings of the Royal Netherlands Academy of Arts and Sciences*, 6, 809–831.
- [4] Minkowski, H. (1908). Space and Time. *Address delivered at the 80th Assembly of German Natural Scientists and Physicians*.
- [5] Misner, C. W., Thorne, K. S., & Wheeler, J. A. (1973). *Gravitation*. W. H. Freeman and Company.
- [6] Schwarzschild, K. (1916). On the Gravitational Field of a Mass Point according to Einstein's Theory. *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften*, 189–196.
- [7] Thalman, B. (2023). Gravity Is Not Attraction; It's a Push (Space-Time Expansion Theory). *Open Journal of Philosophy*, 13(1), 54-68. DOI: 10.4236/ojpp.2023.131004.
- [8] Thalman, B. (2024). Unveiling Gravity: Exploring the Origins of Universal Expansion. *Global Journal of Science Frontier Research*, 24(A3), 1–12. <https://doi.org/10.34257/GJSFRAVOL24IS3PG1>
- [9] Thalman, B. (2024). Gravity Is Space-Time Flow. *Open Journal of Philosophy*.
- [10] Barbour, J., Foster, B., & Ó Murchadha, N. (2002). Relative locality: A new framework for quantum gravity? *Classical and Quantum Gravity*, 19(11), 2739–2750.