Foundations of Flow-Resistance Theory: Time Structure, Norm Relation, and Definition of the Gravitational Field

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Abstract

This article presents the foundations of Flow-Resistance Theory (FRT) in twelve structured points. FRT interprets gravitation not primarily as a force, but as a manifestation of variations in the realized or emergently arising time structure of the physical world. A central distinction in the theory is that between the absolute fundamental speed c_0 and the relative speed of light c. In the present formulation, c_0 is a local, pointwise invariant quantity, whereas c is a nonlocal dynamical quantity expressing differences between separated points of spacetime. On this basis, FRT introduces temporal height Θ, the norm angle θ, and proper time τ, and derives the norm relation $c_0^2 = c^2 + v^2$. Several examples are discussed, including gravitational time dilation, the Lorentz factor, orbital free-fall velocity, and gravitational resistance. The article is conceived as an introductory foundational work and does not yet constitute a complete unification with quantum mechanics, electromagnetism, or cosmology. The present formulation of FRT suggests a common structural basis for both special-relativistic kinematics and gravitational dynamics, without yet claiming a complete field-theoretic unification. In this sense, FRT may be read as a framework in which relativistic motion and gravitational time structure are governed by the same underlying norm relation.

1 Introduction: Why FRT Starts from Realized Structure Rather Than a Static Background

Gravitation is usually described either as a force between masses or—in general relativity—as a geometric effect of curved spacetime. Both approaches are highly successful but differ considerably in their conceptual style. The present work proposes a different interpretive starting point: gravitation is understood as a variation of the locally realized time structure.

The framework developed here is called Flow-Resistance Theory (FRT). Its central hypothesis is that the physical world is best understood not as an entirely static background on which objects move, but as a continuously realized structure whose local manifestation determines the realization of time, light propagation, and motion.

A central principle of FRT is that space and time are not treated as fully given static background entities. Instead, they are interpreted as continuously realized aspects of an underlying physical structure. In this sense, spatial and temporal extension are not primitive final objects, but ongoing manifestations of a deeper expansion-based structure.

The aim of this article is limited and foundational. It introduces the basic conceptual and mathematical elements of FRT and develops the most immediate consequences of the framework. It does not yet attempt a complete unification with quantum mechanics, electromagnetism, or cosmology, but prepares the formal ground for such later developments.

2 The Deeper Interpretive Core of FRT

The deeper interpretive core of FRT may be summarized as follows.

First, FRT assumes an underlying expansion structure associated with a universal fundamental speed c_0.

Second, physical time is interpreted as the realized temporal aspect of this structure.

Third, the local realization of time is regarded as directly linked to the local relative-light-speed structure.

Fourth, mass is interpreted as resistance to this realization and is treated as antivalent to time.

In the present paper, these statements serve as the conceptual background of the theory, whereas the subsequent sections focus on the more formal postulates and their immediate consequences.

The first principle means that FRT does not take an entirely static space as its deepest primitive. Instead, it assumes a more fundamental underlying emergent structure whose characteristic realization is tied to the universal speed c_0.

The second principle states that physical time is not regarded as a wholly independent primitive parameter. Time is interpreted as the realized temporal aspect of the underlying expansion structure.

The third principle means that local time realization is not independent of the locally available relative-light-speed structure. In the formalism developed below, this is expressed through projection from temporal height onto proper time, such that local changes in the relevant light-speed structure directly affect the realized proper time of matter.

The fourth principle interprets mass not merely as an inertial parameter, but as resistance to the local realization of the underlying structure. In this sense, mass stands in an inverse structural relationship to time. The term "antivalent" is used here to denote such an inverse structural relation, which will be elaborated in later work.

3 The Crucial Distinction Between c_0 and c

The defining feature of FRT is the strict conceptual distinction between c_0 and c.

The quantity c_0 denotes the absolute fundamental speed and is local in the strongest sense: at any given point of the realized structure, it is measured as the same invariant quantity.

By contrast, the quantity c is not local in the same sense. In FRT, c is a nonlocal dynamical quantity expressing the difference in expansion dynamics between two separated points of spacetime. It thus describes not a purely pointwise property, but a relational one.

In brief: c_0 is locally invariant, whereas c is nonlocal and comparative. This distinction is among the most important conceptual clarifications of the FRT framework.

The importance of this distinction can hardly be overstated. Without separating c_0 from the relational quantity c, one may easily mistake FRT for a theory of a locally varying "fundamental speed of light." This is not the intended meaning. In FRT, the fundamental speed itself remains locally invariant; what varies is the realized dynamical relation between separated points.

4 Why c_0 Is Always Locally Invariant

Because the underlying expansion is assumed to be locally symmetric, the fundamental speed c_0 remains locally invariant under pointwise measurement. Local symmetry means that the temporal and spatial realization of the structure are affected in a balanced manner.

For this reason, a pointwise measurement reveals no variation in c_0. A measurable difference can arise only across finite distances, over which differences in expansion dynamics may accumulate. In FRT, this accumulated dynamical difference is described not by a change in the fundamental speed itself, but by the relative quantity c.

Thus the distinction between local invariance and nonlocal comparison is built directly into the theory. Put differently: c_0 is the local invariant reference scale of the structure, whereas c expresses the nonlocal result of comparing realized dynamics between separated positions or states.

More precisely, the dynamical difference represented by c arises because mass acts as a local braking influence on the realized expansion structure. Consequently, during a local unit of time defined at a higher point, less spatial distance has been realized at a lower point than at the higher one. The relative-light-speed quantity c therefore describes not a purely local speed value, but the accumulated difference in realized expansion between separated points of the structure. In this sense, c measures a nonlocal dynamical asymmetry induced by gravitational braking.

This also explains why a local observer always finds the same fundamental reference scale, even though large-scale or nonlocal comparisons may reveal differences in realized propagation behavior.

5 Light as Electromagnetic Modulation of the Expansion Structure

Within FRT, light is interpreted not as an independently self-propelled object with its own intrinsic speed, but as an electromagnetic modulation passively carried by the underlying expansion structure.

In this sense, the propagation of light is governed by the realization of the local space-time structure, rather than by the autonomous movement of photons through a prescribed static background.

This yields a natural FRT interpretation of the special-relativistic observation that the speed of light in vacuum is independent of the kinetic speed of the emitting source. The decisive quantity

is not the movement of the source as such, but the expansion dynamics of the surrounding local structure in which light is generated and propagates.

The familiar source independence of vacuum light propagation can therefore be reinterpreted in FRT as a structural consequence: the propagation speed of light is determined by the surrounding realized expansion dynamics, not by an independent "intrinsic speed" of the photon.

This interpretation matters for the entire theory because it directly links the behavior of light to the same realized structure that subsequently determines proper time, gravitational-field strength, and motion.

6 Fundamental Quantities and Notation

We now introduce the fundamental quantities used throughout FRT.

Definition 1 (Absolute fundamental speed). The quantity c_0 denotes the absolute fundamental speed. It is treated as a universal local invariant.

Definition 2 (Relative speed of light). The quantity c denotes the relative speed of light in the FRT sense. It is not a purely local pointwise property, but a nonlocal dynamical quantity expressing differences between separated points of spacetime. Formally, one may write

$$c = c(x, \Theta). \tag{1}$$

It should always be borne in mind, however, that its physical meaning is relational rather than strictly local.

Definition 3 (Kinematic component). The quantity v denotes the kinematic component of motion relative to the local structure.

Definition 4 (Spatial height). The quantity h denotes a spatial height coordinate.

Definition 5 (Temporal height). Temporal height Θ is the time light requires to traverse a spatial height h at the fundamental speed c_0. Thus,

$$\Theta := h/c_0, \; d\Theta := dh/c_0. \tag{2}$$

Θ is the temporal counterpart of spatial height in the absolute FRT reference structure.

Remark 1. In its present formulation, FRT describes gravitation primarily from a body-centered perspective and only secondarily in terms of superpositions of the fields of multiple bodies. For this reason, height measured vertically from the surface of a given body is treated as a central quantity. It is therefore one of the key concepts of FRT.

Definition 6 (Norm angle). The norm angle θ parametrizes the redistribution of the fundamental norm between the realized light/time component and the kinematic component.

Definition 7 (Proper time). The quantity τ denotes the proper time of matter.

7 Formal Postulates, Symmetry, and the Speed-Conservation Principle

The fundamental formal content of Flow-Resistance Theory may be summarized in the following postulates. The central speed-conservation law is derived as a consequence of an underlying continuous symmetry of the quaternionically formulated expansion structure.

Postulate 1 (Absolute fundamental speed). There exists a universal absolute fundamental speed c_0 that is locally invariant at every point of the realized structure.

Postulate 2 (Relative-light-speed structure). The relative speed of light c is a nonlocal dynamical quantity expressing differences in the realized expansion structure across space and temporal height Θ.

Lemma 1 (Quaternionic Noether conservation of the fundamental speed scale). The underlying expansion structure can be represented as a quaternion $q = \Theta + r$, where the scalar part Θ represents local time realization (proportional to the realized light/time component c) and the vector part r represents the spatial/kinematic component (proportional to the kinematic component v). The norm

$$|q|^2 = \bar{q}q = \Theta^2 + |r|^2 = c_0^2$$

is invariant under local unit-quaternion transformations $q \to uq$ with $|u| = 1$. According to Noether's theorem, this yields conservation in the form

$$c_0^2 = c^2 + v^2. \tag{3}$$

Detailed proof sketch with quaternionic Lagrangian density. The expansion structure is described by the quaternionic variable $q = \Theta + r$. A minimal quaternionic Lagrangian density capturing the local realization dynamics is

$$L = \tfrac{1}{2} |D_\mu q|^2 - V(|q|),$$

where $D_\mu = \partial_\mu - iA_\mu$ is a quaternionic covariant derivative (with A_μ as a connection that will later model mass resistance), and V is a potential term representing resistance to realization.

The action $S = \int L \, d^4x$ is invariant under the local unitary transformation

$$q \to u(x, \Theta)\, q, \quad \bar{u}u = 1.$$

The infinitesimal variation $\delta q = i\varepsilon q$ (with real ε) leads, by Noether's theorem, to a conserved current j^μ whose divergence vanishes:

$$\partial_\mu j^\mu = 0.$$

Upon identifying the Noether current with the invariant quaternionic norm $|q|^2$, one obtains the local conservation equation

$$\frac{d}{d\Theta}(c^2 + v^2) = 0.$$

The action of mass as local resistance leads to a redistribution between the scalar (c) and vector (v) parts without changing the total norm c_0^2. The normalized form

$$c^2/c_0^2 + v^2/c_0^2 = 1$$

is the equation of the unit circle and allows the natural phase-angle parametrization $c/c_0 = \cos\theta$, $v/c_0 = \sin\theta$.

Remark 2 (Justification of the local symmetry assumption). The assumption of a continuous local symmetry of the expansion structure is not an arbitrary metaphysical stipulation, but follows from the methodological principle of democratic epistemic access to the laws of nature: the fundamental rules governing the realization of space and time must have the same form at every point for local measurements to be reproducible and comparable. This requirement is the physical counterpart of the equivalence principle and general covariance. It is what first permits application of Noether's theorem and leads to conservation of c_0^2. A violation of this symmetry would mean that local experiments were, in principle, dependent on position and time, which is incompatible with physical experience to date. A more detailed justification and possible relaxations of this assumption will be discussed in a later work.

Postulate 3 (Gravitation as variation of time structure). Gravitation is interpreted as variation of the realized time structure encoded in the behavior of the relative speed of light c.

Postulate 4 (Field definition). The local gravitational-field structure is described by the derivatives

$$\partial c/\partial \Theta \text{ and } \partial(c^2)/\partial h. \tag{4}$$

Remark 3. The derivative $\partial c/\partial\Theta$ describes the temporal aspect of the gravitational field, whereas $\partial(c^2)/\partial h$ describes the spatial aspect. Both quantities encode deformation of the realized expansion structure due to mass resistance.

A central novelty of FRT is thus the speed-conservation principle: the total speed scale c_0^2 is neither locally created nor destroyed; instead, its quadratic norm is preserved while it is redistributed between the realized light/time component and the kinematic component. This conservation follows directly from the local unitary symmetry of the quaternionic expansion structure and provides the common basis for the kinematic and gravitational consequences of the theory.

8 Proper-Time Projection, Field Definition, and Phase-Angle Parametrization

We now derive the immediate kinematic consequences of the norm relation derived in Section 7.

Lemma 2 (Unit-circle form of the normalized FRT relation). The normalized FRT relation reads

$$c^2/c_0^2 + v^2/c_0^2 = 1. \tag{5}$$

This is the equation of the unit circle.

Proof. Divide the fundamental norm relation

$$c_0^2 = c^2 + v^2 \tag{6}$$

by c_0^2.

Proposition 1 (Phase-angle parametrization). Since the normalized FRT relation is the equation of the unit circle, it has the natural parametrization

$$c/c_0 = \cos\theta,\ v/c_0 = \sin\theta. \tag{7}$$

Equivalently,

$$c/c_0 + i(v/c_0) = e^{(i\theta)}. \tag{8}$$

The redistribution of the fundamental norm between c and v can therefore be interpreted as phase-dependent.

Remark 4. This is the simplest mathematical origin of the FRT phase angle. The phase angle does not change the fundamental norm c_0, but determines how this norm is divided between the realized light/time component and motion.

Definition 8 (Proper-time projection). The proper time τ of matter is defined as the projection of temporal height by the relative factor c/c_0:

$$d\tau = (c/c_0)\, d\Theta = \cos\theta\, d\Theta. \tag{9}$$

Remark 5. This definition draws a sharp distinction between Θ and τ. The quantity Θ is a geometric temporal height constructed using c_0, whereas τ is the actually realized proper time of matter in the local structure.

Proposition 2 (Kinematic time dilation). In the purely kinematic case, the norm relation gives

$$c = \sqrt{(c_0^2 - v^2)}, \tag{10}$$

and hence

$$d\tau = [\sqrt{(c_0^2 - v^2)}/c_0]\, d\Theta = \sqrt{(1 - v^2/c_0^2)}\, d\Theta. \tag{11}$$

Proof. Substitute $c = \sqrt{(c_0^2 - v^2)}$ into $d\tau = (c/c_0)d\Theta$.

Remark 6. The familiar special-relativistic kinematic time-dilation structure is thereby reproduced as an immediate consequence of the FRT norm relation and proper-time projection.

The strengths of the gravitational field are then naturally defined through variation of the relative-light-speed structure:

$$\partial c/\partial\Theta,\ \partial(c^2)/\partial h. \tag{12}$$

These derivatives are not independent forces; they encode how the realized structure varies with temporal and spatial height.

A particularly transparent example of the FRT field concept is provided by the measured gravitational time-dilation gradient near Earth. To leading order, the difference in clock rates is

approximately

$$[1/d\tau]\,\partial(d\tau)/\partial h \approx 1.0941 \times 10^{-16}\ \mathrm{m}^{-1}. \tag{13}$$

Since FRT defines proper time by

$$d\tau = (c/c_0)\,d\Theta \tag{14}$$

and $d\Theta$ is constructed using the invariant reference scale c_0, the same relative gradient applies to the realized relative-light-speed factor:

$$(1/c)\,\partial c/\partial h \approx 1.0941 \times 10^{-16}\ \mathrm{m}^{-1}. \tag{15}$$

Equivalently,

$$\partial c/\partial h \approx c\,(1.0941 \times 10^{-16}\ \mathrm{m}^{-1}). \tag{16}$$

Using the spatial FRT field definition through the derivative of c^2 gives

$$\partial(c^2)/\partial h = 2c\,\partial c/\partial h \approx 2c^2\,(1.0941 \times 10^{-16}\ \mathrm{m}^{-1}). \tag{17}$$

Near Earth this yields

$$\partial(c^2)/\partial h \approx 2c_0^2\,(1.0941 \times 10^{-16}\ \mathrm{m}^{-1}). \tag{18}$$

With

$$c_0^2 \approx 8.99 \times 10^{16}\ \mathrm{m}^2/\mathrm{s}^2, \tag{19}$$

one obtains numerically

$$\partial(c^2)/\partial h \approx 19.7\ \mathrm{m/s}^2. \tag{20}$$

Therefore,

$$g \approx \tfrac{1}{2}\,\partial(c^2)/\partial h \approx 9.8\ \mathrm{m/s}^2. \tag{21}$$

In this way, terrestrial gravitational acceleration follows directly from the measured time-dilation gradient once the FRT postulates are applied to the realized relative-light-speed structure.

9 Why Gravitation Is Not a Force in FRT

In a Newtonian picture, gravitation is fundamentally a force acting between masses. In general relativity, gravitation is understood geometrically, through curved spacetime and geodesic motion.

In FRT, gravitation is interpreted as variation of the realized time structure encoded in the relative quantity c, and hence as variation of the realized proper time of matter. Matter changes its motion not primarily because it is pulled directly, but because the realized structure through

which it propagates is different.

The observed effects usually described as gravitational acceleration are therefore secondary consequences of a gradient in time structure. In this sense, gravitation is not a primary force but a structural condition governing the realization of motion and time.

This interpretive shift is one of the defining characteristics of FRT. It aims to replace the force-centered perspective with a realization-centered one.

A deeper mathematical interpretation of free fall in FRT can be obtained from the height-dependent development of realized spatial volume. In such a formulation, the spatial derivatives of the volume-development function lead to a corresponding distance function describing the reduction of separation in free fall. Falling motion is then interpreted not primarily as the effect of a direct attractive force, but as the consequence of a downward-directed change in the realized expansion structure itself. This also explains why the freely falling body remains locally force-free: it is not driven by a direct pull, but follows the changing spatial realization. The detailed functional form of this volume-based description will be developed in a later article.

10 Three Illustrative Consequences of the FRT Framework

A further advantage of the FRT framework is that several familiar physical relations emerge directly and transparently from the norm structure derived in Section 7.

10.1 Gravitational Time Dilation and Atomic Clocks

A particularly simple and empirically transparent illustration of the FRT picture is provided by measurements of gravitational time dilation using atomic clocks. Since FRT defines proper time by

$$d\tau = (c/c_0)\, d\Theta, \tag{22}$$

the measured time-dilation factor corresponds directly to the relative-light-speed factor:

$$d\tau/d\Theta = c/c_0. \tag{23}$$

Precision clock measurements can therefore be reinterpreted within FRT as direct probes of the realized time-structure relation. In this way, the gravitational field can be inferred from measured differences in clock rates by reconstructing the function $c(h, \Theta)$ and its gradients. In particular, the spatial aspect of the field can be expressed through $\partial(c^2)/\partial h$, whereas the temporal aspect is formally represented by $\partial c/\partial\Theta$.

10.2 The Lorentz Factor

A second immediate consequence of the FRT norm relation is the Lorentz factor, which can be derived particularly transparently. Starting from the speed-conservation principle derived in Section 7,

$$c_0^2 = c^2 + v^2, \tag{24}$$

one first isolates the realized light/time component:

$$c^2 = c_0^2 - v^2. \tag{25}$$

Dividing by c_0^2 gives

$$c^2/c_0^2 = 1 - v^2/c_0^2. \tag{26}$$

Since c is a realized speed quantity, one takes the positive square root and obtains

$$c/c_0 = \sqrt{(1 - v^2/c_0^2)}. \tag{27}$$

Inverting this relation gives

$$c_0/c = 1/\sqrt{(1 - v^2/c_0^2)}. \tag{28}$$

This is precisely the Lorentz factor:

$$\gamma = c_0/c = 1/\sqrt{(1 - v^2/c_0^2)}. \tag{29}$$

The significance of this result in FRT is that the Lorentz factor γ is not introduced as an external kinematic expression, but arises directly as the ratio between the universal fundamental speed scale c_0 and the realized light/time component c. In other words, γ measures the factor by which the locally realized light/time component has been reduced relative to the full fundamental norm.

The same result follows immediately from the proper-time projection. Since FRT defines

$$d\tau = (c/c_0)\, d\Theta, \tag{30}$$

we have

$$d\tau/d\Theta = c/c_0. \tag{31}$$

Therefore,

$$d\Theta/d\tau = c_0/c. \tag{32}$$

Consequently,

$$\gamma = d\Theta/d\tau = c_0/c. \tag{33}$$

This shows that the Lorentz factor in FRT is not merely a kinematic correction factor, but a direct expression of the projection from temporal height onto realized proper time.

Finally, the normalized FRT relation

$$c^2/c_0^2 + v^2/c_0^2 = 1 \tag{34}$$

shows that the Lorentz factor is embedded in the same unit-circle structure that leads to phase-angle parametrization:

$$c/c_0 = \cos\theta,\ v/c_0 = \sin\theta. \tag{35}$$

Accordingly,

$$\gamma = 1/\cos\theta. \tag{36}$$

This provides a compact geometric interpretation: relativistic time dilation arises because the realized light/time component is the cosine projection of the full fundamental norm.

10.3 Orbital Free-Fall Velocity

A third simple consequence of the speed-conservation principle appears in orbital free fall. If the local gravitational potential scale is expressed by

$$Gm/r, \tag{37}$$

the orbital velocity follows immediately as

$$v_orb = \sqrt{(Gm/r)}. \tag{38}$$

In this sense, the familiar orbital free-fall velocity is not introduced in FRT as an independent law, but appears as a direct consequence of redistributing the conserved total speed scale c_0^2 between the time-structure component and the kinematic component.

11 The Two Central Interpretive Relations of the Present FRT Formulation

These examples naturally lead to the central interpretive relations of Flow-Resistance Theory.

The first is the fundamental norm relation

$$c_0^2 = c^2 + v^2. \tag{39}$$

It expresses that the universal speed scale c_0^2 is redistributed between the realized light/time component c^2 and the kinematic component v^2.

The gravitational potential scale is interpreted in FRT as the deviation of the realized light/time component from the void state ("void" in the cosmological sense: the region of space far from masses). The void state is defined by $c = c_0$. A working identification is therefore

$$c_0^2 - c^2 = Gm/r. \tag{40}$$

Together with the norm relation, this immediately gives

$$v^2 = Gm/r. \tag{41}$$

In FRT, the ratio m/r is regarded as an intrinsic gravitational resistance property of the body. This motivates introducing a gravitational resistance quantity

$$R_G = R_G(m/r, h, \Theta), \tag{42}$$

where the gravitational constant G acts as a proportionality factor for the strength of gravitational braking.

12 Relationship to Established Frameworks and Outlook

At its present stage, FRT should be understood as a foundational framework and not yet as a completed alternative to established theories.

Its kinematic sector reproduces the familiar time-dilation structure through the norm relation and proper-time projection. Its gravitational sector introduces a field interpretation based on variations of c and c^2. In weak-field regimes, this suggests a natural connection to classical potential concepts.

At the same time, interpreting mass as resistance to time realization suggests a deeper antivalent relation between mass and time. A further important consequence is the possibility of direct experimental tests of the distinction between c_0 and c using optical resonators in different gravitational environments.

The present formulation of FRT suggests a common structural basis for both special-relativistic kinematics and gravitational dynamics, without yet claiming a complete field-theoretic unification. In this sense, FRT can be read as a framework in which relativistic motion and gravitational time structure are governed by the same underlying norm relation.