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

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Abstract

This article [1] presents the foundations of the 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 emergent, time structure of the physical world. A central distinction of the theory is that between the absolute fundamental speed c_0 and the relative light speed 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, 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 intended as an introductory foundations paper and not yet as 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 final 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 static background

Gravitation is usually described either as a force acting between masses or, in general relativity, as a geometric effect of curved spacetime. Both approaches are highly successful, yet they differ strongly in 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 not best understood as a fully static background populated by moving objects, but rather 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 full 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 taken to be 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, while the subsequent sections focus on the more formal postulates and their immediate consequences.

The first principle means that FRT does not begin from a fully 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 an entirely 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 the projection from temporal height to proper time, so 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 inert parameter, but as resistance to the local realization of the underlying structure. In this sense, mass stands in an inverse structural relation to time. The term *antivalent* is used here to denote such an inverse structural relation, which will be developed more fully in later work.

3 The decisive distinction between c_0 and c

The decisive 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 therefore does not describe a purely pointwise property, but a relational one.

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

The importance of this distinction can hardly be overstated. If one does not distinguish the pointwise invariant quantity c_0 from the relational quantity c, then the FRT picture is easily misread as a theory of locally varying "fundamental light speed." 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 way.

For this reason, a pointwise measurement does not reveal a variation of c_0. A measurable difference can arise only across finite distances, where differences in the expansion dynamics may accumulate. In FRT, this accumulated dynamical difference is described not by a change of 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 the realized dynamics between separated positions or states.

More specifically, the dynamical difference represented by c arises because mass acts as a local braking influence on the realized expansion structure. As a consequence, during one local time unit 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 does not describe 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 helps to explain 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 an intrinsic speed of its own, but as an electromagnetic modulation passively transported by the underlying expansion structure.

In this sense, the propagation of light is governed by the realization of the local spacetime structure rather than by an autonomous motion of photons through a pre-given static background.

This yields a natural FRT interpretation of the special-relativistic observation that the vacuum speed of light is independent of the kinetic velocity of the emitting source. The decisive quantity is not the motion of the source as such, but the expansion dynamics of the surrounding local structure in which the light is generated and propagated.

Thus, the familiar source-independence of vacuum light propagation may be re-read in FRT as a structural consequence: the propagation speed of light is determined by the surrounding realized expansion dynamics and not by an independent "self-speed" of the photon.

This interpretation is important for the whole theory because it links the behavior of light directly to the same realized structure that later also governs proper time, gravitational field strength, and motion.

6 Fundamental quantities and notation

We now introduce the basic 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 light speed)**.** *The quantity c denotes the relative light speed 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*

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

while keeping in mind that its physical meaning is relational rather than strictly local.

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

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

Definition 5 (Temporal height)**.** *The temporal height Θ is the time required for light, propagating with the fundamental speed c_0, to traverse a spatial height h. Thus,*

$$\Theta := \frac{h}{c_0}, \qquad d\Theta := \frac{dh}{c_0}. \tag{2}$$

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 fields from 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 parameterizes the redistribution of the fundamental norm between the realized light/time share and the kinematic share.*

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

7 Formal postulates and the speed-conservation principle

The formal foundational content of FRT may be summarized in the following postulates.

Postulate 1 (Absolute fundamental speed)**.** *There exists a universal absolute fundamental speed c_0.*

Postulate 2 (Relative light-speed structure)**.** *The relative light speed c is a nonlocal dynamical quantity associated with differences in realized structure across space and temporal height.*

Postulate 3 (Norm relation)**.** *Motion and relative light-speed structure satisfy the norm relation*

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

Postulate 4 (Gravitation as time-structure variation)**.** *Gravitation is interpreted as a variation of the realized time structure, encoded in the behavior of c.*

Postulate 5 (Field definition)**.** *The local gravitational field structure is described by the derivatives*

$$\boxed{\frac{\partial c}{\partial \Theta} \qquad \textit{and} \qquad \frac{\partial c^2}{\partial h}.} \tag{4}$$

Remark 2. *The derivative $\partial_\Theta c$ describes the temporal aspect of the gravitational field, whereas $\partial_h c^2$ describes the spatial aspect.*

A central novelty of FRT is therefore the *speed-conservation principle*: the total speed scale c_0^2 is not destroyed or created locally, but redistributed between a realized light/time share c^2 and a kinematic share v^2.

8 Proper-time projection, field definition, and phase-angle parametrization

We now derive the immediate kinematic consequences of the norm structure.

Lemma 1 (Unit-circle form of the normalized FRT relation)**.** *The normalized FRT relation reads*

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

This is the equation of the unit circle.

Proof. Divide the basic norm relation

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

by c_0^2 . □

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

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

Equivalently,

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

Hence, the redistribution of the fundamental norm between c and v may be interpreted as phase-dependent.

Remark 3. *This is the simplest mathematical origin of the FRT phase angle. The phase angle does not alter the fundamental norm c_0, but determines how this norm is partitioned between realized light/time share 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:*

$$\boxed{d\tau = \frac{c}{c_0}d\Theta = \cos\theta d\Theta.} \tag{9}$$

Remark 4. *This definition distinguishes sharply between Θ and τ. The quantity Θ is a geometric temporal height built 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 yields*

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

and therefore

$$d\tau = \frac{\sqrt{c_0^2 - v^2}}{c_0}d\Theta = \sqrt{1 - \frac{v^2}{c_0^2}}d\Theta. \tag{11}$$

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

Remark 5. *Thus the standard (SRT) kinematic time-dilation structure is reproduced as an immediate consequence of the FRT norm relation and the proper-time projection.*

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

$$\frac{\partial c}{\partial \Theta}, \qquad \frac{\partial c^2}{\partial h}. \tag{12}$$

These derivatives do not represent independent forces, but encode how the realized structure changes across temporal and spatial height.

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

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

Since FRT defines proper-time by

$$d\tau = \frac{c}{c_0} d\Theta, \tag{14}$$

[2]

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

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

Equivalently,

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

Using the spatial FRT field definition through the derivative of c^2, one obtains

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

Near the Earth, this gives

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

Since

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

[2]In this sense, Eqs. (12)–(15) may be interpreted as deriving a deformation-rate quantity of the realized expansion flow from measured gravitational time dilation. The quantity $\partial c/\partial h$ then plays a role formally analogous to a deformation-rate term in fluid mechanics, except that here the deformed "flow" is the realized expansion structure of space-time itself.

this yields numerically

$$\frac{\partial c^2}{\partial h} \approx 19.7\ \frac{m}{s^2}. \tag{20}$$

Therefore,

$$\boxed{g \approx \frac{1}{2}\frac{\partial c^2}{\partial h} \approx 9.8\ \frac{m}{s^2}.} \tag{21}$$

In this way, the 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 a variation of the realized time structure, encoded in the relative quantity c, and therefore as a variation of the realized proper time of matter. Matter does not primarily change its motion because it is directly pulled, but because the realized structure through which it propagates is different.

Thus the observed effects that are usually described as gravitational acceleration are secondary consequences of a gradient in the 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 features of FRT. It aims to replace the force-centered perspective by a realization-centered one.

A deeper mathematical interpretation of free fall in FRT may be obtained from the height-dependent development of the realized spatial volume. In such a formulation, the spatial derivatives of the volume-development function lead to a corresponding distance function that describes the reduction of separation in free fall. The falling motion is then interpreted not primarily as the effect of a direct attractive force, but as the consequence of a downward change in the realized expansion structure itself. This also helps to explain 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 physically familiar relations arise directly and transparently from the basic norm structure.

10.1 Gravitational time dilation and atomic clocks

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

$$d\tau = \frac{c}{c_0}\, d\Theta, \tag{22}$$

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

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

Hence, precision clock measurements may be reinterpreted in FRT as direct probes of the realized time-structure relation. In this way, the gravitational field can be inferred from measured clock-rate differences by reconstructing the function $c(h, \Theta)$ and its gradients. In particular, the spatial field aspect may be expressed through $\partial_h c^2$, while the temporal aspect is represented formally by $\partial_\Theta c$.

10.2 The Lorentz factor

A second immediate consequence of the FRT norm relation is the Lorentz factor, which can be derived in a particularly transparent way. Starting from the basic FRT speed-conservation principle,

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

one first isolates the realized light/time share:

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

Dividing by c_0^2 gives

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

Taking the positive square root, since c is a realized speed magnitude, one obtains

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

Inverting this relation yields

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

This is precisely the Lorentz factor:

$$\boxed{\gamma = \frac{c_0}{c} = \frac{1}{\sqrt{1 - \frac{v^2}{c_0^2}}}.} \tag{29}$$

The significance of this result in FRT is that the Lorentz factor γ is not introduced as an external kinematic expression, but appears directly as the ratio between the universal fundamental speed scale c_0 and the realized light/time share c. In other words, γ measures by which factor 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

$$d\tau = \frac{c}{c_0}\, d\Theta, \tag{30}$$

one has

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

Therefore,

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

Hence

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

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

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

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

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

Accordingly,

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

This provides a compact geometric interpretation: relativistic time dilation arises because the realized light/time share 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

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

then the orbital velocity follows immediately as

$$v_{\text{orb}} = \sqrt{\frac{Gm}{r}}. \tag{38}$$

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

11 The two central interpretive relations of the present FRT formulation

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

The first is the fundamental norm relation

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

It expresses that the universal speed scale c_0^2 is redistributed between the realized light/time share c^2 and the kinematic share v^2. A further refinement is required in the interpretation of the gravitational potential scale. The basic FRT norm relation should not be read as implying that the classical quantity Gm/r is in general identical with the full norm c_0^2.

Such a complete equality is not expected for arbitrary mass-radius combinations. Rather, FRT interprets the gravitational potential scale as the deviation of the realized light/time share from the void state. [3]

The void state is defined by the limiting field-free realization

$$c = c_0. \tag{40}$$

This state should not be confused with c_0 alone as an abstract constant. The quantity c_0 denotes the universal total speed scale of the underlying space-time structure, whereas the void corresponds to the special realized state in which the relative light-speed factor c reaches this maximal value.

In this sense, the gravitational potential is not taken as an absolute quantity, but as a difference relative to the void realization. A simple FRT working identification is therefore

$$\boxed{c_0^2 - c^2 = \frac{Gm}{r}.} \tag{41}$$

This relation [4] states that the classical potential scale Gm/r measures how much the realized light/time share c^2 is reduced relative to the void reference c_0^2 .

[3] "Void" in the cosmological sense. Void is the area of space far from masses, as contrast to the space areas with huge mass concentrations.

[4] This relation is understood as a heuristic identification that links the reduction of the realized light/time share to the classical potential; it is not yet derived from a variational principle and will be replaced by a more rigorous dynamical equation in a forthcoming paper.

Combined with the norm relation

$$c_0^2 = c^2 + v^2, \tag{42}$$

this immediately yields

$$\boxed{v^2 = \frac{Gm}{r}.} \tag{43}$$

Hence the gravitational potential scale can be interpreted as the complementary share of the total norm that appears in the kinematic sector. In this form, the speed-conservation principle and the potential concept become directly connected.

This interpretation is especially natural if one assumes that a given combination of mass and radius induces a phase-dependent redistribution of the fundamental norm. In a deeper formulation of FRT, one may therefore think of the pair (m,r) as determining a phase angle that governs the partition between c and v. The exact functional dependence of this angle is not yet fixed in the present introductory article. What is relevant here is only the structural idea: gravitating bodies do not alter the fundamental norm c_0, but change the realized distribution between its light/time share and its kinematic share.

A particularly significant consequence of the FRT norm relation is that gravitation and self-driven motion may be understood as two complementary forms of the same underlying redistribution process. In the gravitational case, the surrounding field reduces the realized c-share and thereby generates the complementary v-share. In the case of self-driven motion, the direction is reversed: the body imposes an increase of the realized v-share and thereby reduces the complementary c-share. In this sense, gravitation and active motion are not treated as fundamentally separate categories, but as structurally equivalent mechanisms acting on the same conserved norm $c_0^2 = c^2 + v^2$. At the present stage, this should be understood as a structural equivalence rather than yet as a fully formulated new equivalence principle. Nevertheless, it points toward a deeper unification in which gravitational and inertial phenomena arise as complementary redistributions of one and the same total norm. A fuller mathematical development of this equivalence and its dynamical consequences will be given in a later article.

A further conceptual difference from the Newtonian picture concerns the meaning of the radius parameter r. In FRT, quantities of the form m/r are not interpreted using a variable center distance to the field point. Instead, r refers to the physical radius of the gravitating body itself and therefore characterizes an intrinsic resistance property of that body. The dependence on the external location is introduced separately through the notion of height, and more generally through the combined height structure involving h and Θ.

In this way, the ratio

$$\frac{m}{r} \tag{44}$$

acquires a more autonomous physical meaning within FRT, namely as a measure of intrinsic gravitational resistance, while the actual field realization is determined by its coupling to the surrounding height structure.

For this reason, FRT naturally motivates the introduction of a gravitational resistance quantity R_G, understood not merely as a Newtonian distance-dependent factor, but as a structured resistance quantity combining the intrinsic body parameter m/r with the external height dependence of the field. In schematic form, one may therefore write

$$R_G = R_G\left(\frac{m}{r}, h, \Theta\right). \tag{45}$$

[5] Within this interpretation, the gravitational constant G acts as the proportionality factor that translates mass into gravitational braking strength. Put informally, G measures how much gravitational braking effect is associated with a given amount of mass when expressed on the potential scale.

From a broader perspective, FRT is characterized by two particularly distinctive notions: first, the speed-conservation principle, and second, the gravitational resistance quantity. Together, these concepts replace the usual separation between kinematics and gravitation by a single structural framework.

Only in special limiting cases should one expect a complete saturation of the fundamental norm. Such extremal situations, including possible Planck-scale and black-hole interpretations, lie beyond the scope of the present introductory paper and will be treated separately.

12 Relation to established frameworks and outlook

At the present stage, FRT should be understood as a foundational framework rather than 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, the interpretation of mass as resistance to time realization suggests a deeper antivalent relation between mass and time. Since this relation leads directly toward quantum-mechanical questions, its detailed mathematical formulation is deferred to a later article. A natural next step of the FRT framework is therefore the formulation of this deeper antivalence relation and its possible connection to phase-based quantum dynamics. [6]

[5] A detailed mathematical definition of R_G and its dynamical role will be developed in later work.

[6] In a broader FRT perspective, the local formalism developed in the present article may be embedded in a cosmological picture in which the underlying structure is connected to primordial, or initial, expansion of the underlying structure. Within such an interpretation, the continuously realized space-time structure considered here would represent the local manifestation of a deeper expanding upper-space dynamics. A fuller mathematical description of this broader framework may naturally involve quaternionic structures. At a deeper level, the fundamental speed scale c_0 may therefore possess a structured or complex character, though this is not required for the elementary formalism developed in the present paper.

A further important consequence of the Flow-Resistance Theory (FRT) framework is that it suggests the possibility of direct experimental tests of the distinction between the invariant fundamental speed c_0 and the nonlocal relative light-speed quantity c. In principle, a suitably designed two-laser experiment in a gravitational setting may offer a way to probe whether the realized relative light-speed structure can be operationally distinguished from the invariant reference scale. The reason why such a distinction may become measurable is that the eigenfrequencies of an optical resonator depend directly on the realized propagation speed inside the resonator. For a vacuum cavity of effective length L, the longitudinal eigenmodes satisfy

$$\nu_q = \frac{q\,c}{2L}, \qquad q \in \mathbb{N}, \tag{46}$$

where q denotes the longitudinal mode number. Thus, any change in the realized relative light-speed quantity c would appear as a corresponding shift of the resonance frequencies. More generally, in a medium with refractive index n, the relation would take the form

$$\nu_q = \frac{q\,c}{2nL}, \tag{47}$$

whereas for a vacuum resonator one simply has $n = 1$. A two-laser comparison between resonators placed under different gravitational conditions could therefore, in principle, test whether the realized relative light-speed structure differs operationally from the invariant reference scale c_0. The detailed design and analysis of such a test lie beyond the scope of the present introductory article and will be treated separately.

The present formulation of FRT suggests a common structural basis for both special-relativistic kinematics and gravitational dynamics, without yet claiming a complete final 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.