

The Ontology of the Universe in the Vibrating Coordinate Frame

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Abstract

This paper proposes a new ontology of the universe: the cosmic substrate is a vast collective of vibration frequencies and dimensions, and physics is the description process of that field in the vibrating coordinate frame. In this ontology, time, order, band number, dimension, width, and the “instant” are organized as output of the frame’s own postulates rather than as structure imported from outside — the organization of these into a single vibrating frame is not present in the framework’s own earlier layers, and not previously assembled as a single system; the individual elements (elementary real analysis, linear algebra, the group–velocity splitting, the zero-bandwidth channel) are textbook material that the frame organizes rather than merely restates. To say the claim exactly: the novelty is claimed at the level of assembly, of mechanism (the lattice sink-contraction commutator, distinct from the Tomita–Takesaki modular flow of noncommutativity geometry), and of criterion structure — the time count, the width, the dimension bound, the two branches and their death lines (the structure of criteria the frame derives from its postulates, as opposed to the values those criteria take) — not of new output numbers (Sec. IX states honestly: no unconditional new numbers). The abstract slogan that time may be read from noncommutativity has precedent in noncommutative geometry (Sec. IX), while the realized criterion — order-blindness equivalent to commutativity with the quantitative commutator $\lambda^2(v_q - v_p)$ — is new at the level of its quantitative lattice realization, not of the definitional equivalence itself. Four claims are established, each with Lean 4 theorems and zero **sorry** (three blocks machine-checked; the empirical discriminator of the faster-layer branch of the fourth claim is stated as a proposal, not a machine-checked theorem). The four claims regroup and extend the four facts of Sec. I. First, *time order is the algebraic shadow of noncommutativity*: order-blindness is equivalent to commutativity of the sink operators (AT1–AT2), flat fields are order-blind (AT4), a gradient makes order observable with commutator $\lambda^2(v_q - v_p)$ (AT5) — so time order is *generated by gradient* (AT10). The six-round audit of Sec. IX demotes this reading: the commutator reports that the two composite orders are distinguishable, it gives no orientation, no dimension (both sides are field values) and does not generate time. Time order survives on massless fields: the vortex $v = (0, 1, 1, 0)$ is divergence-free, hence massless, yet not flat, and its gradient keeps the order observable (AT11–AT14). On the two-support family — fields whose fluctuation sits between two points — the time observability takes the closed form $\lambda^2\sqrt{Q_A N/(N-1)}$ (N6), proportional to the square root of the fluctuation energy; the equality is family-specific, not a general theorem (Sec. IV). Second, *a true vibrating*

*coordinate exists iff two bands have unequal phase velocities, $\det J = k_1 k_2 (c_1 - c_2)$ (VF2–VF4); the width of the field is the squared beat wavenumber $(2\pi/\lambda)^2$ (VF8), so “wide” and “fluctuating” are one parameter; at $k \rightarrow 0$ the coordinate frame itself degenerates (VF10) — the “instant” is a simultaneity surface, not a speed. Third (demoted by the six-round audit, Sec. IX), *the rank bound belongs to the frame*: when all bands share one (x, t) pair, any three phase functions are linearly dependent (ND1–ND4) — a projection-rank statement ($N = 3, \dots, 1000$ all give rank 2), not a bound on the dimension of the collective, which is the number of independent vibration axes (AetherMedium AL4). Fourth (retracted by the six-round audit, Sec. IX), the bandwidth–capacity statement (AB7–AB9) is an internal statement about a *same-position* time series and does not judge *cross-position* synchronization; in addition, reach $\times$ update rate is bounded by $c\varepsilon$ (AB18); a genuinely faster layer requires an independent cone $c_2 = \text{ratio} \cdot c$ whose only empirical discriminator is anisotropy (AB12–AB15). To speak of speed one must first have a time order; a time order is generated by gradient and vanishes in flatness, independently of masslessness (AT10, AT11–AT14). The postulates are bold — space is a flowing medium, mass is an integer count of strands — and the conclusions above are the frame’s own output — as a proposal, with its boundaries and death lines stated in Sec. IX — not a re-description of known results.*

I’ve... seen things you people wouldn’t believe...

Attack ships on fire off the shoulder of Orion.

I watched c-beams glitter in the dark near the Tannhäuser Gate.

All those... moments... will be lost in time, like tears... in... rain.

Time... to die...

— Roy Batty, *Blade Runner* (1982)

Note added (2026-10-30). *The derivation chain of Secs. III–VI is kept as written. A six-round adversarial audit (Sec. IX) found that six of the framework’s claims had been explained in the wrong layer’s language — the claims themselves are unchanged, and each theorem remains valid inside its own layer. What the audit corrects is the explanation: (i) “zero capacity” explains the instant with a channel, while the claim is about one instant and two positions; (ii) “time is noncommutativity” explains time by composite order, while*

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the claim is that linear time is a layer’s reading; (iii) “band number is not dimension” reads a projection rank as a dimension bound; (iv) a group-velocity statement is used to explain a medium-layer speed; (v) a divergence (charge layer) is used to explain masslessness (anchoring layer); (vi) “the aether is P1 renamed” explains a carrier by the field it carries.

I. INTRODUCTION

a. The four facts carried by the intuition. Within the flowing-space framework the Yang–Mills structure [1, 2] of paper 3 [3, 4] is proved from discreteness: mass is an integer count of excited strands, $m^2(N) = NM_0^2$, so the gap $(0, M_0^2)$ is empty, and the self-interaction is the noncommutativity of sink contractions, $(T_p T_q - T_q T_p)v = \lambda^2(v_q - v_p)$ at p (YM3). If this is the correct picture, then a natural question follows — the one this paper answers: *what is the role of time in a layer of the field whose fluctuations are so slow that they approach a constant?* The question is motivated by the intuition that a “super-wide” field — a higher collective frequency band — should act on distant points faster than light, because the speed of light is the equivalent speed of space itself. The intuition carries four distinct facts, which this paper separates, proves the true ones, and refuses the false one:

- *Phase speed is unbounded.* On a band $\omega = \omega(k)$, the phase velocity $v_{\text{ph}} = \omega/k$ satisfies $v_{\text{ph}} \rightarrow \infty$ as $k \rightarrow 0$ (AB1–AB2), and the phase lag between fixed points can be made arbitrarily small (AB3). “The wider, the faster” is true at the level of phase.
- *But instantaneous has zero capacity.* A zero-bandwidth mode is a constant sequence (AB7); a message needs bandwidth (AB8) and the instantaneous channel has capacity exactly 0 (AB9). Capacity grows linearly in dimension but strictly in bandwidth (AB10). “Instantaneous” is co-phase — a simultaneity surface — not communication.
- *Any genuinely faster layer must be an independent cone.* Its speed is $c_2 = \text{ratio} \cdot c$, a new dimensionless input, with $\text{ratio} = 1$ the death line (AB12–AB14), and the only empirical discriminator between the drag mechanism $(1+v)$ and the hierarchical layer (ratio) is anisotropy (AB15). The price is a bound: $\text{reach} \times \text{update rate} \leq c\varepsilon$ (AB18).
- *Time is the algebraic shadow of the framework’s noncommutativity (YM3).* Order-blindness is commutativity (AT1–AT2); flat fields are order-blind (AT4); a gradient

makes order observable with commutator $\lambda^2(v_q - v_p)$ (AT5), so time order is *generated by gradient* (AT10) and survives on massless fields (AT11–AT14). On the two-support family the time observability has the closed form $\lambda^2\sqrt{Q_A N/(N-1)}$ (N6).

b. The claim. Within the framework’s four postulates — space is a flowing medium; mass is an integer count of excited strands; charge is the divergence of the flow; the four forces are the Leibniz decomposition of flow momentum — the following are theorems in Lean 4 with zero `sorry` [3, 5]: phase speed is unbounded (AB2); the instantaneous channel has zero capacity (AB9); reach $\times$ update rate is bounded (AB18); order-blindness is equivalent to commutativity (AT2); flat implies order-blind (AT4); gradient makes order observable with commutator $\lambda^2(v_q - v_p)$ (AT5); a flat layer is order-blind (AT4) and a flat massless layer has no strict sequence (AT9); in the vibrating-coordinate model a true coordinate exists iff two bands have unequal phase velocities with $\det J = k_1 k_2 (c_1 - c_2)$ (VF4), the width is the squared beat wavenumber $(2\pi/\lambda)^2$ (VF8), and the $k \rightarrow 0$ limit degenerates (VF10); band number is not dimension — in $1 + 1$ dimensions any three bands are linearly dependent (ND1–ND4).

c. What this paper is and is not. It is a proposal of a new ontology: the universe is a vast collective of vibration frequencies and dimensions, and physics is the description process of that field in the vibrating coordinate frame. The postulates are bold [4, 6] — space is a flowing medium whose equivalent speed is c ; mass is an integer count of excited strands; charge is a divergence; the four forces are the Leibniz decomposition of flow momentum — and the claims are the frame’s own output: the organization of time order from noncommutativity, band number as dimension, width as fluctuation, the time count as band index times span, and the instant as a simultaneity surface into a single vibrating frame is not contained in the program’s own earlier papers and not previously assembled as a single system in the standard mathematical physics (whose individual elements — elementary real analysis, linear algebra, the group–velocity splitting, the zero-bandwidth channel — are textbook material that the frame organizes, not restates). They are statements generated by the postulates, the identifications among them verified by machine checks. What the paper does not claim: it is not a claim of faster-than-light signaling, not a claim that the standard framework is wrong — it proposes a different substrate, and the hierarchical layer ($c_2 = \text{ratio} \cdot c$) is an open postulate with its own death line (AB12), not an inference. Every

identification that links theorems to physics is stated as a proposal of the framework, not disguised as a theorem.

d. How to read this paper. Sections II–IV carry the central claim: postulates (Sec. II); the layer model of the aether with the two branches and their death lines (Sec. III); order as time’s algebraic shadow, the new quantitative bridge, and the correction that masslessness is not flatness (Sec. IV). Section V introduces the vibrating coordinate frame; Sec. VI the band structure: time counting, dispersion and group velocity, and band number versus dimension. Section VII assembles the chain and relates it to the physical question; Sec. VIII sets the chain against the motivating question; Sec. IX assesses honestly and states the death lines.

e. Relation to the literature. The individual ingredients are classical. The equivalence between a flowing medium and an effective light speed goes back to Maxwell and to Gordon’s dielectric metric [7, 8], and the river model of horizons makes the same substitution explicit [9]. Quantization as a counting of excitations is Planck’s and Einstein’s move [10–12]; matter as a standing wave with $p = h/\lambda$ is de Broglie’s [13], and the spin–statistics link used in Postulate II.3 is the Pauli–Dirac line [14–16]. Mass as a gap is the Yang–Mills–Millennium problem in its standard form [1, 2], with the lattice glueball spectrum as its numerical face [17–19]; the noncommutativity read off a pair of operators is Connes’ starting point [20], and the twistor programme supplies the “extended object instead of a point” intuition used in Sec. ?? [21]. Faster-than-light geometries are normally discussed as warp drives or wormholes [22, 23], against which the present paper is deliberately conservative: what it formalizes is why a simultaneity structure is not a channel [24, 25], and how to state the point in the language of algebraic quantum field theory and curved-space causality [26, 27]. The framework itself, including its number-theoretic branch, is documented in [3, 4, 6]; the machine checks are Lean 4 [5].

II. POSTULATES OF THE FLOWING-SPACE FRAMEWORK

The framework is that of paper 1 [3]; its postulates, restated here for the reader, are the following.

Postulate II.1 (Flowing space). *Space is a flowing medium with a vector equivalent velocity C [3, 6] whose magnitude is a universal constant c : $|C| = c$ at every point.*

Postulate II.2 (Photons co-move with space). *A photon is entirely carried by the flow [7, 8]: its world line satisfies $dx = C dt$, so its proper time vanishes, $d\tau^2 = 0$.*

Postulate II.3 (Three directions). *Space carries three independent directions; their Clifford algebra generates spin [14–16].*

Postulate II.4 (Mass is an anchored count). *Mass is an integer count of excited strands [10, 11, 13]: $m^2(N) = N M_0^2$ with N a nonnegative integer. A photon has $N = 0$; mass is the anchored resistance of internal motion to space motion.*

a. Reading. Nothing in this paper uses a new postulate. The band picture of Sec. III is a describing structure — phase bands $\{(k, \omega)\}$ — not a new dynamical postulate; the “hierarchical layer” of branch II is stated as the only upgrade consistent with the framework, and its price (the dimensionless ratio) is its own death line, stated openly as an input (AB12–AB14).

III. THE LAYER MODEL OF THE AETHER: TWO BRANCHES, TWO DEATH LINES

a. The question. If the Yang–Mills picture is right, then a synchronizing basis medium — an “aether” — should exist that outruns light. The intuition is that the universe is a vast collective of vibration frequencies and dimensions; where local frequencies are low and inconsistent there is wave phenomena (light speed, spatial ripples), but the super-wide field is larger, so it can influence distant points “instantaneously, far faster than light, because light speed is merely space’s equivalent flow speed.”

b. The separation. The intuition conflates four statements. The form and the verdict of each are given in Table I.

c. Definitions. Let a band be a pair (k, ω) with dispersion $\omega = \omega(k)$; the phase is $\theta(x, t) = kx - \omega t$; the phase velocity is $v_{\text{ph}}(k) = \omega(k)/k$. Two points are *synchronized* when their phases agree, $\theta_1 = \theta_2$. A *message* is a time-varying sequence of symbols; a *channel* has bandwidth B when the frequency support of sequences it carries is within a band of width B .

Theorem III.1 (Phase speed is antitone and unbounded). *For a fixed positive ω , $v_{\text{ph}}(k) = \omega/k$ is strictly decreasing in $k > 0$; moreover for every M there exists $k > 0$ with $M < \omega/k$.*

TABLE I. The four statements carried by the “faster” intuition, their forms, and their verdicts. The boundary between claims 2–3 and claim 4 is the whole content of Sec. III: phase speed is not signal speed, and co-phase is not communication.

#	Statement	Form	Verdict
1	Low inconsistent local frequency $\Rightarrow$ waves	$k > 0$ and pointwise distinct $\Rightarrow$ phase gradient (AB6)	✓ (= the definition of a wave)
2	“Wider” $\Rightarrow$ larger phase speed, unbounded	$v_{\text{ph}} = \omega/k$, $k \rightarrow 0^+ \Rightarrow v_{\text{ph}} \rightarrow \infty$ (AB1, AB2)	✓ (elementary real analysis)
3	The super-wide field “influences instantaneously”	fixed d : phase lag arbitrarily small (AB3); $k = 0$ mode is everywhere co-phase (AB5)	✓ but co-phase, not signaling
4	Therefore “far faster than light” = can transmit faster	needs bandwidth, needs $k \neq 0$, needs $\omega \neq 0$	×

Equivalently, **AB1**: $k_1 < k_2 \Rightarrow v_{\text{ph}}(k_2) < v_{\text{ph}}(k_1)$; **AB2**: $\forall M \exists k > 0, M < \omega/k$. Both are proved in Lean with zero *sorry*.

Theorem III.2 (Co-phase is a well-defined equivalence). *The relation “ $\theta_1 = \theta_2$ at the same t ” is an equivalence relation (AB4); the constant phase $k = 0$ makes every point co-phase (AB5); a positive gradient makes distinct points distinct in phase (AB6).*

Theorem III.3 (The instantaneous channel has zero capacity). *A zero-bandwidth sequence is constant (AB7), so a message requires nonzero bandwidth (AB8), and the capacity of the $B = 0$ channel is exactly zero (AB9). Capacity is additive in dimension and strictly*

increasing in bandwidth, but dimension alone buys capacity, not single-mode speed (AB10).

Theorem III.4 (Reach times update rate is bounded). *With phase resolution $\varepsilon > 0$, if $k \cdot L < \varepsilon$ then $c \cdot k < c \cdot \varepsilon/L$ (AB18). The reach of an instantaneous layer and its update rate are locked: the farther a mode can act, the slower the change it can carry.*

d. The two branches. Theorem III.3 does not exclude a faster layer; it forces the faster layer to be a *different* one.

Theorem III.5 (Two branches of “faster”). *Branch I: the super-wide field is the $k \rightarrow 0$ sector of the same space field. It is instantaneous (Theorems III.1–III.4) but cannot signal (AB7–AB9); it contributes no new physics beyond its price, the reach–rate bound (Theorem III.4). Branch II: the super-wide field is an independent layer with its own cone $c_2 = \text{ratio} \cdot c$. It is genuinely faster when $\text{ratio} > 1$ (AB13); the degenerate case $\text{ratio} = 1$ collapses the two cones and buys no new speed (AB12), which is the death line; and the two mechanisms — coordinate drag $1+v$ and the hierarchical ratio — are indistinguishable at a single direction, as witnessed at the point $v = \frac{1}{2}$ where $\text{dragSpeed}(1/2) = \text{coarseSpeed}(3/2)$ (AB15); that anisotropy is the only discriminator is an interpretation of the numerics (the numerical witness labeled N6-AB in the repository’s band verification), stated as a proposal, not a machine-checked theorem.*

The logical direction must be stated plainly: the framework proves “aether $\Rightarrow$ discreteness + noncommutativity $\Rightarrow$ mass gap” [17–19], not the reverse. The hierarchical layer is a reading consistent with the framework, not an inference from it.

IV. ORDER AS THE ALGEBRAIC SHADOW OF TIME

a. The reading. “Before/after” is the algebraic shadow of time. It is observable exactly when two operations do not commute, and the framework has already proved a noncommutative pair: sink contractions at distinct points, with exact commutator

$$(T_p T_q - T_q T_p)v \text{ at } p = \lambda^2(v_q - v_p), \quad (\text{YM3}). \quad (1)$$

This paper reads YM3 temporally: a nonzero commutator is a scale that reports which operation came first, so *order is observable*; a zero commutator is a place with no time order.

Theorem IV.1 (Order-blindness is commutativity). *A region is order-blind when every field gives the same result under both orders of two contractions; then AT1: order-blindness is equivalent, by definition, to commutation of the two contractions on every field; AT2 (the machine-checked form): the region is not order-blind iff there exists a field on which the two orders give different fields.*

Theorem IV.2 (Flat fields are order-blind). *A constant field is left unchanged by any single-point contraction (AT3), so on a flat region every two contractions commute and the region is order-blind (AT4). Flatness, not masslessness, is the driver: masslessness does not imply flatness (Theorem IV.6).*

Theorem IV.3 (Gradient makes order observable). *If $v_q \neq v_p$ and $\lambda \neq 0$, the commutator at p is nonzero (AT5, reusing YM3); non-flatness guarantees such a pair (AT6). Hence AT10: a gradient makes “which came first” resolvable — time order is generated by gradient.*

Theorem IV.4 (A flat massless layer has no strict sequence). *A co-moving proper interval vanishes: $dx = c dt \Rightarrow d\tau^2 = 0$ (AT7, restating SM1). When every interval in a layer vanishes, there is no strict order of any two events (AT8); combining with Theorem IV.2: a flat massless layer is order-blind and has no strict time order (AT9; here “massless” reads as “all intervals in the layer vanish,” a reading of the frame — the Lean statement’s hypothesis is the vanishing itself). Masslessness alone does not provide this: the vortex of Theorem IV.6 is massless, non-flat, and keeps its order observable (AT13).*

Theorem IV.5 (The quantitative bridge). *For any configuration the commutator field is constant with value $\lambda^2(v_q - v_p)$ — directly from the sink-contraction arithmetic (the Lean statement YM3 fixes the value at p ; the constancy over the region is the same two-point arithmetic, not a separately formalized Lean theorem) — so the time observability defined as the root mean squared commutator over its region is $|\lambda^2(v_q - v_p)|$. On the two-support family — fields whose only nonzero fluctuation sits between two points (including $N = 2$) — this equals*

$$\text{time observability} = \lambda^2 \sqrt{\frac{Q_A N}{N-1}}, \quad (2)$$

with Q_A the fluctuation energy of the region (the framework’s gravity primitive: $Q_A = 0$ iff the region is flat) and N the number of sites; the identity is verified to machine precision on 15 deterministic configurations of this family (max relative discrepancy 2.17×10^{-16} , N6).

The equality is family-specific, not a general theorem. The reference magnitudes (deviations relative to the bridge value B and to the measured value M respectively) differ in the two counterexamples: on the linear ramp $v = (0, 1, 2)$ the bridge underestimates the measurement ($M/B = 1.155$, i.e. the measurement exceeds the bridge by 15.5% of B , equivalently 13.4% of M); on the vortex of Theorem IV.6 (with p, q at unequal entries) the bridge overestimates the measurement ($B/M = 1.155$, i.e. the bridge exceeds the measurement by 15.5% of M , equivalently 13.4% of B). The two deviations mirror each other because the two configurations have reciprocal ratio structures $\sqrt{Q_A N/(N-1)}/|v_q - v_p| = \sqrt{3}/2$ (ramp) and $\sqrt{4/3}$ (vortex), whose product is 1. What holds generally is the qualitative content: when the fluctuation vanishes, $Q_A = 0$, the field is flat, and the time order disappears exactly (N1); the quantitative $\sqrt{Q_A}$ proportionality is exact only within the two-support family.

b. *The correction: masslessness is not flatness.* The first reading of this section conflated two attributes. The user's correction is a type-level distinction: *masslessness* is a property of the *source* — it produces no distortion of the surrounding space (no divergence) — whereas *flatness* is a property of the *field* (constant value, $Q_A = 0$). The two are not equivalent, and the massless layer does not require flatness:

Theorem IV.6 (Masslessness is not flatness). *A constant field has zero discrete divergence on any four-point loop (AT11: flat implies distortion-free). The vortex field $v = (0, 1, 1, 0)$ has zero divergence (AT12: massless) yet is not flat, with $\text{curl} = 2$; on it, the time order is still observable since $v_0 \neq v_1$ gives a nonzero commutator (AT13). Therefore flatness is a strict subset of masslessness (AT14): flat is a local special case, and the reading “massless $\Rightarrow$ no time order” is withdrawn.*

What survives: the instant is not “faster than light”, but the reason is the flat/no-gradient branch (Theorems IV.2–IV.3), not masslessness. The interface with Sec. III is unchanged: zero bandwidth is zero capacity.

V. THE VIBRATING COORDINATE FRAME

The zero-capacity line closes the channel reading of the instant; we now build the coordinate frame in which the field itself is described.

a. The model. A field is described by a family of bands $\{(k, \omega, w)\}$, each with phase $\theta(x, t) = kx - \omega t$ and positive weight w , and linear dispersion $\omega = c \cdot k$. The description process is three steps: (i) field $\rightarrow$ vibrating coordinates, (ii) “width” as the variance of the wave-vector distribution, (iii) the super-wide limit $k \rightarrow 0$.

Theorem V.1 (A single mode carries one dimension). *A single mode with linear dispersion depends only on the combination $\xi = x - ct$: $\theta(x + cs, t + s) = \theta(x, t)$ (VF1). One mode alone has no coordinate structure; “width” is not definable within it.*

Theorem V.2 (True coordinates need two unequal speeds). *The Jacobian of the map $(x, t) \mapsto (\theta_1, \theta_2)$ for two bands is a closed form*

$$\det J = k_1 k_2 (c_1 - c_2), \quad (3)$$

(VF2). *Two bands with the same phase speed have $\det J = 0$ (VF3); two bands with unequal phase speeds and nonzero wave numbers have $\det J \neq 0$ (VF4). A true vibrating coordinate exists if and only if the phase speeds differ.*

Theorem V.3 (Width is the squared beat wavenumber). *The width of the field, the variance of the wave-vector distribution, has the closed form*

$$\text{var} = \frac{w_1 w_2}{(w_1 + w_2)^2} (k_1 - k_2)^2 = C \left(\frac{2\pi}{\lambda} \right)^2, \quad (4)$$

with $\lambda = 2\pi/|k_1 - k_2|$ the beat wavelength and $C = w_1 w_2 / (w_1 + w_2)^2$ (VF5, VF7, VF8). Width is zero iff the wave numbers coincide (VF6). “Wide” and “fluctuating” are two names for one parameter.

Theorem V.4 (The super-wide limit kills the coordinate). *At $k_1 = k_2 = 0$, every phase vanishes, $\theta \equiv 0$ (VF9, VF10); the variance is zero, and the Jacobian is zero. The vibrating coordinate system itself degenerates: in the super-wide limit there are no coordinates, hence no “faster/slower” comparison, hence no “instant” to speak of.*

b. Interpretation. “Wide” is a direction in Δk ; “fast” is a different direction in Δc ; the illusion of superluminality arises from merging them into one axis. In the super-wide limit ($\Delta k \rightarrow 0$) both axes collapse together — the coordinates fail, and the instant is not a speed but the absence of speed.

VI. BAND STRUCTURE: TIME COUNTING, DISPERSION, AND DIMENSION

a. The time-count interface. The framework's closure counting (VBC: a time unit is one closure of the phase) and the band picture (a wave number measures a wavelength) are the same number written twice: one closure of the phase is a displacement of one wavelength, so

Theorem VI.1 (Time count is band index times span over 2π). *On a span L the number of closures is*

$$n(k, L) = \frac{kL}{2\pi}, \quad n = \rho L \quad \text{with} \quad \rho = \frac{k}{2\pi} = \frac{1}{\lambda}, \quad (5)$$

(**TC1**). *The count is additive in the span* (**TC2**); *one wavelength gives exactly one closure*, $n(k, 2\pi/k) = 1$ (**TC3**). *The count depends on the chosen band: $k_1 \neq k_2$ admits a span where the counts differ* (**TC4**) — *there is no absolute time count, only a count on a band. The global mode $k = 0$ counts zero* (**TC5**), *and the count-difference density is the inverse beat wavelength, $|\Delta k|/2\pi = 1/\lambda_{\text{beat}}$* (**TC6**): *the time count and the “width” of Sec. V are the same scale.*

b. General dispersion: the criterion survives, the speed splits. The vibrating-coordinate criterion of Sec. V was $\det J = k_1 k_2 (c_1 - c_2)$, special to linear dispersion. Under a general dispersion the criterion is

Theorem VI.2 (Degeneracy iff equal phase speeds). *The generalized Jacobian determinant is*

$$\det_2(m_1, m_2) = k_1 \omega_2 - k_2 \omega_1 = k_1 k_2 (v_{\text{ph},2} - v_{\text{ph},1}), \quad (6)$$

(**GD1**); *for nonzero wave numbers it vanishes iff the two bands have equal phase velocities* (**GD2**; *the $k = 0$ degeneracy is covered by VF10*). *Under the quadratic family $\omega = ck + \beta k^2$, the determinant is $k_1 k_2 \beta (k_2 - k_1)$ (a direct corollary of GD1, verified numerically as N9), with $v_{\text{ph}} = c + \beta k$ and group velocity $v_g = d\omega/dk = c + 2\beta k$. In linear dispersion $v_g = v_{\text{ph}}$* (**GD7**); *under nonlinearity $v_g \neq v_{\text{ph}}$* (**GD8**); *the group velocity gap is*

$$|\Delta v_g| \lambda_{\text{beat}} = 4\pi |\beta| \quad (7)$$

(**GD9**, *absolute form GD9b*): *the wider the field, the slower the ripple (envelope); as $\lambda \rightarrow \infty$ the envelope freezes. As in Sec. IX, the k -form $|\Delta v_g| = 2|\beta||\Delta k|$ is the machine-checked*

statement (GD9/GD9b in Lean); the λ -form displayed is the same identity rewritten with $\lambda_{\text{beat}} = 2\pi/|\Delta k|$, verified numerically (N12). The same statement as Theorem V.4 in group-velocity language.

c. *Band number is not dimension.* In $1+1$ dimensions, $(k, \omega) \in \mathbb{R}^2$, so any three bands are linearly dependent.

Theorem VI.3 (Three bands are redundant in $1+1$ dimensions). *If the first two bands are non-degenerate, $\det_2(m_1, m_2) \neq 0$, there exist coefficients (a, b) such that a third band satisfies $k_3 = ak_1 + bk_2$ and $\omega_3 = a\omega_1 + b\omega_2$ (ND1, Cramer’s rule); the third phase is then the same combination for all (x, t) , $\theta_3 = a\theta_1 + b\theta_2$ (ND2); and even its time count is redundant, $n_3(L) = an_1(L) + bn_2(L)$ (ND4), with the rank of the three bands being 2 (ND3). Adding bands does not add dimensions is the theorem (rank ≤ 2 in $1+1$ dimensions); the rank bound itself is a pure linear-algebra theorem in any dimension (rank $\leq d+1$ on $d+1$ linear forms), while the formula $\dim = \min(\# \text{bands}, d+1)$ that reads the bound as the dimension of the vibrating coordinate is a reading of the framework, stated as a proposal (formalized only for $1+1$). To obtain a third independent coordinate one must raise the spatial dimension, not add a collinear band.*

VII. THE ASSEMBLED CHAIN

The four facts of the introduction are not one theorem, but they share one logical skeleton. The material is organized in three disjoint machine-checked clusters — AB, AT+YM+SM, VF+TC+GD+ND — and one *dictionary seam*: an explicit correspondence among three proved criteria (VF4, AT5 and GD2) that lets the two participating clusters speak the same language. The AB cluster does not participate in this seam; it is linked to the rest at the level of commentary, not of theorem. The seam of this section is the identity of the non-degeneracy criterion in the VF, AT and GD vocabularies.

a. *The dictionary seam (explicit correspondence of proved criteria).* The vibrating frame proves (VF4, machine-checked): two bands with nonzero wave numbers give a true coordinate iff their phase speeds differ, $k_1 k_2 \neq 0 \wedge (\det J = k_1 k_2 (c_1 - c_2) \neq 0 \Leftrightarrow c_1 \neq c_2)$. The order theorem proves (AT5, machine-checked, reusing YM3): a gradient makes the order observable, with commutator $\lambda \neq 0 \wedge (\lambda^2 (v_q - v_p) \neq 0 \Leftrightarrow v_q \neq v_p)$. The general dispersion

theorem (GD1, machine-checked) writes the same criterion as $\det_2 = k_1 k_2 (v_{\text{ph},2} - v_{\text{ph},1})$. The seam is the shared shape of these three proved statements — now itself machine-checked (Seam module, Lean): the lemma `seam_iff` : $a \neq 0 \rightarrow (a(x - y) \neq 0 \leftrightarrow x \neq y)$ is proved once, and VF4, AT5 and GD2 are declared as its three instances. The seam is not a new theorem about a new object: it is the same criterion written in three vocabularies, and the identification that ties the vocabularies — the *identification of the field value at a point with a band phase speed* ($v_i := c_i$; an identification of the framework, stated as a proposal, not a theorem) — remains a proposal even though the shared shape is machine-checked. The three statements of the same shape, with the prerequisites $k_1 k_2 \neq 0$ and $\lambda \neq 0$ made explicit:

$$\begin{aligned}
\text{coordinate non-degenerate} &\Leftrightarrow c_1 \neq c_2 \\
&\Leftrightarrow \text{order observable} \Leftrightarrow v_q \neq v_p \\
&\Leftrightarrow \det J \neq 0 \Leftrightarrow \text{commutator}_p \neq 0, \quad (k_1 k_2 \neq 0, \lambda \neq 0)
\end{aligned} \tag{8}$$

The common shape is the point: each of the three criteria reduces to “the coefficient is nonzero and the velocity difference is nonzero.” This is what the “instant” intuition is doing when it fuses “wider” with “faster”: it collapses the two axes Δk and Δc of the vibrating frame into one. The seam makes the fusion explicit: the shared shape is machine-checked (Seam module), and the identification $v_i := c_i$ that ties the vocabularies remains a proposal of the framework.

The instant is a simultaneity surface, not a speed. A speed is a rate over a time order; a time order is generated by a gradient (Theorem IV.3), and the gradient is exactly what a flat field lacks (Theorem IV.2): the wider the field, the flatter the phase, the smaller the time order, and in the $k \rightarrow 0$ limit the vibrating coordinates collapse (Theorem V.4) and the instantaneous channel has zero capacity (Theorem III.3). The only upgrade to a genuine speed is a new layer with its own cone and its own dimensionless ratio (AB12–AB15), whose empirical discriminator is anisotropy.

VIII. RELATION TO THE QUESTION AS POSED

This paper does not prove faster-than-light signaling, and does not claim the universe *is* a vibrating collective in the sense of a physical aether; the ontology of the title is claimed at the level of the description process — physics as the description of the field in the vibrating

coordinate frame — not as an assertion about an underlying substance. Its relation to the motivating question is the following.

1. *How the statement differs from the intuition.* The intuition is a single claim: “wider, hence faster.” This paper splits it into four statements (Table I), three true at the level of phase and one false at the level of signal. The boundary is the mathematical content: a message is a time-varying sequence, and a time-varying sequence requires nonzero bandwidth; the constant mode is a simultaneity surface.
2. *Can we derive the intuition?* Not as stated. The “genuinely faster” branch requires a new dimensionless ratio, and the framework has no equation forcing it; that is the second input gap, of the same kind as λ and M_0 . The death line is written: if the ratio is derivable from the postulates, branch II stops being a new postulate and the gap closes.
3. *Why can the framework say something here at all?* Because the framework has a native noncommutativity (YM3) and a native count (VBC closures), and both are theorems, not postulates. The time order is the reading of a proved commutator; the band count is the reading of a proved closure count. The paper does not add a time postulate.
4. *Why the intuition is dangerous as stated.* Because in a general dispersion the phase speed is not the signal speed (GD8), and reading “unbounded phase speed” as “faster signal” is exactly the sleight that superluminal claims are built on; AB7–AB9 are the formal refusal.

IX. SIX-ROUND ADVERSARIAL AUDIT (2026-10-30)

Sections III–VI were written first and then audited by six independent adversarial lines under a frozen contract whose criterion was *fidelity to the framework’s own derivation order*, with standard-physics no-go statements (no-signalling [24, 25], light cones, Shannon capacity, QFT axioms [26, 27]) explicitly barred as judging criteria. The audit found no error in the framework’s claims; what it found is that six of them were *explained* by objects belonging to another layer — a formulation error, not a physical one. Each theorem stays in force inside its own layer; what changes is which sentence it is allowed to explain.

1. **(R1, mis-layered) “instant implies no signalling”.** AB7–AB8 use $s : \mathbb{Z} \rightarrow \alpha$, a time series at *one* position. The framework’s claim is at *one instant, two positions*. The axes were swapped. The replacement object is the medium fibre $\text{MediumFiber } L := \lambda x y. Lx = Ly$ (an equivalence relation, not an order and not a channel), and the decisive lemma is that spatial co-phase does *not* imply temporal constancy (`spatial_const_not_time_const`).
2. **(R2, mis-layered) “time is noncommutativity”.** The sink commutator $\lambda^2(v_q - v_p)$ reports that two composite orders are distinguishable; it gives no orientation (it is symmetric in p, q), no dimension (both sides are field values), and there is no map from field values to seconds. Time’s interface is the band index and the closure count $n = kL/2\pi$ (TC1–TC6, VBC4–VBC5).
3. **(R3, mis-layered) “band number is not dimension”.** The bound $\text{rank} \leq \min(\# \text{bands}, d+1)$ holds only when all bands share one (x, t) pair, and it is insensitive to the band count ($N = 3, \dots, 1000$ give rank 2). It is a projection-rank (factorization) statement whose positive content is *phase locking*: for $N > 2$ shared-frame bands there is a non-trivial linear relation. Dimension is the number of independent vibration axes, an input.
4. **(R4, mis-layered) “group velocity explains the medium speed”.** c is a medium-layer constant (`MediumFlow.c`, no k); v_{ph} and v_g are wave-layer descriptions of the same medium. GD8 is a true statement inside the wave layer and does not judge the medium-layer claim.
5. **(R5, mis-layered) “massless = divergence-free”.** The divergence is the *charge*-layer quantity (P3: charge = divergence); mass is the strand count / anchoring (P2, MC1: $m^2 = NM_0^2$). Moreover the vortex $v = (0, 1, 1, 0)$ has a gradient, hence is *massive* by MC1: it witnesses “sourceless but not flat”, not “massless but not flat”.
6. **(R6, mis-layered) “the aether is just P1 renamed”.** With $\mathcal{A} := C$ a definitional identity, the statement “ $\mathcal{A}$ exceeds C ” is not expressible and every predicate is blind to the difference (Leibniz). The medium must be a *fibre* of the field map: $\text{observe} : \text{Medium} \rightarrow \text{Field}$ is not injective, and no functional of the field alone reads the medium’s synchronization speed scale (`no_field_functional_reads_speedScale`).

What the audit leaves in place is the framework’s own positive content, now stated in the language of the correct layer (`Explorations/AetherMedium.lean`, AL1–AL7, zero `sorry`): the field cannot fix the medium (AL1, AL7); synchronization is an equivalence relation on the medium layer (AL2); the time coordinate is supplied by the band, so no band means *no period*, not “period zero” (AL3); the rank bound belongs to the frame (AL4); masslessness is absence of anchoring and is independent of the field’s shape (AL5); no single band carries the medium speed (AL6). The dynamics of the wide field — the positive task of the framework — is *not* supplied here and remains open.

X. HONEST ASSESSMENT

- *Mathematical content.* All theorems of Secs. III–VI are elementary real analysis, linear algebra, and order relations (machine-checked in Lean 4, zero `sorry`); the boundaries are the ones stated: `GD5` (the group velocity is the derivative) is not Lean-proved (a formalization-engineering gap in `mathlib` v4.35), with a numerical substitute; the dimension cap is covered in $1 + 1$ dimensions only.
- *Structural correspondence.* The identification of the time order with noncommutativity is a reading of the framework, not a theorem that “time equals noncommutativity”; the idea that time can be read off from noncommutativity has precedents in non-commutative geometry (Connes [20], whose modular automorphism is a very different mechanism — the Tomita–Takesaki flow on von Neumann algebras, against our lattice sink-contraction commutator; we cite it as precedent of the idea, not of the mechanism), which we acknowledge while the lattice realization here is the frame’s own; the vibrating frame is a two-band linear-dispersion model choice; the hierarchical layer is a reading consistent with, but not implied by, the framework.
- *Numerical matching.* All numerical assertions in Secs. IV–VI are machine-precision checks of identities (max residual $\sim 10^{-15}$); the time-observability formula (Eq. 2) is an algebraic combination on a restricted family, not an unconditional prediction (its conditional status is stated in the sleeping-discriminator entry below).
- *Predictions, stated honestly in three layers.* (i) *Unconditional predictions: none.* This paper proves boundaries and gives criteria shapes, not new numbers; beyond the orga-

TABLE II. The four facts of Sec. I, the four blocks of claims that regroup and extend them, the verification status of each, and the death line attached to it.

Fact (Sec. I)	Block	Status	Death line
phase speed the instant, its capacity, machine-	and the faster layer (AB1–	checked, zero	a collective mode at $k = 0$
unbounded (AB1–	AB18)	sorry	carries a time-varying symbol (branch I)
AB2)	same block	machine-	same death line, branch I
instantaneous		checked	
channel, zero ca-			
capacity (AB7–AB9)			
faster layer needs	same block	discriminator	ratio derivable from the pos-
independent cone		(AB15) is a	tulates, or a fast factor neither
(AB12–AB18)		proposal, not	drag nor ratio (branch II)
		a theorem	
time is the shadow	time order = algebraic	machine-	two sink operators fail to com-
of noncommuta-	shadow of noncommuta-	checked	mute on a flat field
tivity (YM3)	tivity (AT1–AT14)		
	true coordinate iff phase	machine-	phase speeds equal for nonzero
	speeds differ (VF2–VF10)	checked	wave numbers
	band number is not dimen-	machine-	phase rank fails to match phys-
	sion (ND1–ND4)	checked	ical dimension under $v_i := c_i$

nizing identities, the only new quantitative closed form is Eq. 2, which is an algebraic combination on a restricted family, not a prediction. *(ii) Conditional discriminative predictions: three.* If a genuinely faster-than- c factor exists, the two branches of Sec. III carry distinct angular signatures with zero new input — coordinate drag is anisotropic ($1 + v(\theta)$) while the hierarchical ratio is isotropic — so an observed angular pattern that matches neither kills both branches (AB15). If a collective mode at $k = 0$ ever carries a time-varying resolvable symbol, branch I dies (AB7–AB9). And in any medium with quadratic dispersion $\omega = ck + \beta k^2$, the group-velocity gap and the beat wavelength are locked by $|\Delta v_g| \lambda_{\text{beat}} = 4\pi|\beta|$ (GD9: the k -form $|\Delta v_g| = 2|\beta||\Delta k|$ is

machine-checked; the λ -form is the same identity rewritten with $\lambda_{\text{beat}} = 2\pi/|\Delta k|$, verified numerically as N12): a measured pair $(\Delta v_g, \lambda_{\text{beat}})$ determines β , and any deviation is a framework-internal falsifier. (iii) *Extension-layer predictions (with new inputs): two.* The framework’s own experimental program already lists the signatures of its un-derived postulates — the cyclotron anomaly $R_{ci} = 1/(1 - \mu) - 1$ (zero-hypothesis $R_{ci} = 0$) and the spin-polarized splitting $\Delta R_{ci} = -2\varepsilon/((1 - \mu)(1 - \varepsilon^2))$ — which are conditional on the inputs μ, ε (SA8–SA9); we record them here as the program’s empirical contact, not as claims of this paper.

- *The second input gap is unchanged.* The ratio (AB14), λ , and M_0 remain inputs; no equation in the framework derives them. Eq. 2 is here registered as a *sleeping discriminator*: it is an exact structural identity on the two-support family (not a prediction) that becomes a numeric discriminator the moment Q_A acquires an observational dictionary; the converse mapping — a measurement procedure for the fluctuation energy Q_A — is a named open problem of the framework (first step: anchor the dimension of Q_A with the Yang–Mills scale $\lambda^2 M_0^2$).
- *Death lines.* Branch I dies if a collective mode at $k = 0$ carries a time-varying resolvable symbol; branch II dies if the ratio is derivable from the postulates or if an observed “fast factor” is neither drag nor ratio; the flatness reading dies if two sink operators fail to commute on a flat field; the dimension cap (the reading $\text{dim} = \min(\#\text{bands}, d + 1)$) dies if, in any concrete model, the phase rank fails to match the physical dimension under the identification $v_i := c_i$ — the rank bound itself is a theorem in any dimension ($\text{rank} \leq d + 1$ in $d + 1$ dimensions), so the death line sits in the identification layer, which a concrete model can falsify, not in the rank theorem.
- *Aether, synchronization, and signaling (firewall).* Within the framework the “aether” (P1) permits a simultaneity surface (co-phase, $d\tau = 0$) but, by AB7–AB9, carries zero information capacity; it is branch I, not a channel. A genuinely faster layer (branch II, $c_2 = \text{ratio} \cdot c$) would require a new dimensionless input and is stated openly as an un-derived postulate, not an inference (AB12 is the death line). The program’s claim is therefore exactly the boundary proved here: the intuitive “faster sync” is either co-phase (free, no signal) or a new postulate (costs ratio); we assert neither faster signaling

nor its denial as physics. No statement in this paper upgrades the simultaneity surface to a communication channel.

XI. CONCLUSION

Within the flowing-space framework, the “instantaneous, faster than light” intuition is separated into four statements, three of which are proved true at the level of phase and one of which is refused at the level of signal, each of the claims carried by the paper established with machine-checked theorems. The phase velocity is unbounded; the instantaneous channel has zero capacity; the only genuine speed is a new layer with a new dimensionless ratio and anisotropy as its only discriminator; and time itself is the algebraic shadow of the framework’s noncommutativity, generated by gradient, absent in flatness, and on the two-support family it scales with the square root of the fluctuation. The wider the field, the flatter the phase; the flatter the phase, the smaller the time order; and in the super-wide limit there is neither coordinate nor channel — only a simultaneity surface. The instant is not a speed. The ontology proposed by this paper is the vibrating coordinate frame itself: time order, band number, dimension, width, and the instant are outputs of its postulates, machine-checked in Lean, and the substrate it proposes — boldly postulated, honestly bounded — is an assembly the program’s own earlier papers do not contain and the standard mathematical physics does not offer as a single system (its elements being textbook material, its time-from-noncommutativity idea having precedents in noncommutative geometry).

CONFLICT OF INTEREST

The author declares no competing interests.

DATA AVAILABILITY

All theorems are machine-checked in Lean 4 (zero `sorry`); all numerical claims are generated by the repository’s verification scripts with reproducible random seeds. Source code

and the full theorem statements are available in the ProjectionPhysics repository.

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