Vedic Science, International Multidisciplinary Peer Reviewed Research Journal
Vol. 28, Issue April- June 2026, PP. 103-124
ISSN No. 0975-0312
DOI: https://doi.org/10.66718/vsj.v28.i2.08

Variable Light Speed and Cosmic Scale Measurement

Electromagnetic Wave Propagation in the Info-Magneto-Electrostatic (IME) Cosmos

Dr Satinder Singh Malik

Independent Researcher in the Foundations of Physics and Philosophy of Science

ORCID: 0000-0002-6743-2102

Abstract

This paper develops a mechanical account of the propagation of electromagnetic waves, and of light in particular, within the Info-Magneto-Electrostatic (IME) framework, in which space is not an empty void but a real, formatted, compressible medium called the celestial plenum. The central proposal is a position dependent speed of light. Where the medium is relaxed and of low density, as in the deep intergalactic void far from any rotating body, the wave propagates slowly. Where the medium is compressed and magnetically tensioned, as in the local solar and galactic vortices in which the Earth is nested, the wave reaches its terrestrial maximum value of about 299,792 kilometres per second. Because a slower wave takes more time to arrive, an observer who assumes the full local speed everywhere systematically overestimates the distance to a remote source and therefore overestimates the scale and the recession rate of the cosmos.

The mechanism is built in stages. The plenum is treated as a dielectric fluid obeying fluidic conservation laws, formatted at the smallest scale into a space filling lattice of rhombic dodecahedral information cells. A toroidal magnetic field, the Rajasic drive, threads this lattice and tensions it by a macroscopic pinch, the cosmic analogue of the laboratory Z pinch. The speed of a transverse disturbance is set by the ratio of this magnetic tension to the plenum density, in the manner of a wave on a tensioned membrane, so that the speed falls where the tension relaxes. The cosmos is modelled as a set of embedded rotors, a grand cosmic toroid containing a galactic toroid containing a solar toroid, so that the field measured at any point is the cumulative product of all three nested step downs, with natural breakpoints at the heliopause, the galactic boundary, and the cosmic boundary.

A three-tier cascade with a containment step down factor of one half per tier, anchored to the in situ plasma transition recorded by the Voyager 1 and Voyager 2 probes at the heliopause, yields an intergalactic speed of light near 65,000 kilometres per second, about 0.217 of the terrestrial value. Applied to cosmic scale measurement, this single correction reproduces the gap between the locally measured Hubble constant near 73 kilometres per second per megaparsec and the early universe value near 67 kilometres per second per megaparsec, and so offers a refractive rather than an expansionary reading of cosmological redshift. The inverse square distribution of light is derived as a face counting theorem on the lattice, with the exponent fixed at two by the three dimensionality of space. The roles of the three energies, the subtle information field, the magnetic field, and the dense plenum foam, are set out as a carrier and modulation hierarchy, and the behaviour of light near stars, dark stars, and the most luminous quasars is explained by the local magnetic gradient. The paper states its assumptions, conjectures, and falsification criteria openly, and confronts the decisive observational test, the time dilation of distant supernova light curves, without evasion.

Keywords

Variable speed of light, celestial plenum, Info-Magneto-Electrostatic cosmos, rhombic dodecahedral lattice, magnetic Z pinch, embedded vortex model, Voyager heliopause, Hubble tension, cosmological redshift, inverse square law, refractive deceleration, falsifiability.

1. Introduction

1.1 The measurement problem: distance read from travel time

Almost everything known about the large scale cosmos is inferred from light. A distance is not measured with a ruler but reconstructed from the time a signal takes to arrive and from an assumed propagation speed. The reconstruction rests on one quiet assumption, namely that the speed of light has the same value along the entire path as the value measured in a terrestrial laboratory. If that assumption fails, every inferred distance, every recession velocity, and the inferred size and age of the cosmos inherit the error. The present paper questions exactly this assumption and traces the consequences for cosmic scale measurement.

The reasoning of the framework can be stated in a single sentence before any mathematics. If light travels more slowly through the sparse intergalactic medium than through the dense local medium, then the signal from a remote source takes longer to arrive than a constant speed calculation predicts. An observer who divides that long travel time by the full local speed concludes that the source must be very far away. Slowness is read as distance. The apparent vastness of the cosmos would then be, in part, a refractive illusion rather than a literal extent.

1.2 A short history of theories of light, and their drawbacks

The IME proposal is best understood against the long argument over what light is. The history has oscillated between two pictures, the particle and the wave, and finally fused them, while quietly discarding the medium that the wave picture originally required. Table 1 summarises the principal stages and the difficulties each left unresolved.

Era and author	Theory of light	Core claim	Principal drawback
c. 1670, Newton	Corpuscular	Light is a stream of particles obeying mechanics (Newton, 1952).	Cannot explain diffraction, interference, or partial reflection without ad hoc fits.
1690, Huygens	Wave in an ether	Light is a wave in a space filling medium (Huygens, 1912).	Required a luminiferous ether whose properties seemed self contradictory.
1865, Maxwell	Electromagnetic wave	Light is a transverse oscillation of the electromagnetic field; $c = 1/\sqrt{(\mu_0\varepsilon_0)}$ (Maxwell, 1865).	Left open what physically oscillates and what the field is a state of.
1887, Michelson and Morley	Null ether drift	No motion of the Earth through a static ether detected (Michelson and Morley, 1887).	Interpreted as no medium at all, rather than as a co-moving or dragged medium.
1905, Einstein	Photon and invariance	Light is quantised, and c is an invariant of spacetime.	Constancy of c becomes a postulate; the medium is removed from physics.
1920, Einstein (later)	Ether of general relativity	Space must possess physical properties (Einstein, 1922).	The acknowledged medium was never given a mechanical constitution.
1990s, VSL programme	Varying speed of light	c may vary, chiefly in the early universe (Moffat, 1993; Albrecht and Magueijo, 1999; Barrow, 1999).	Variation placed in the cosmic past; spatial variation by environment left largely unexplored.

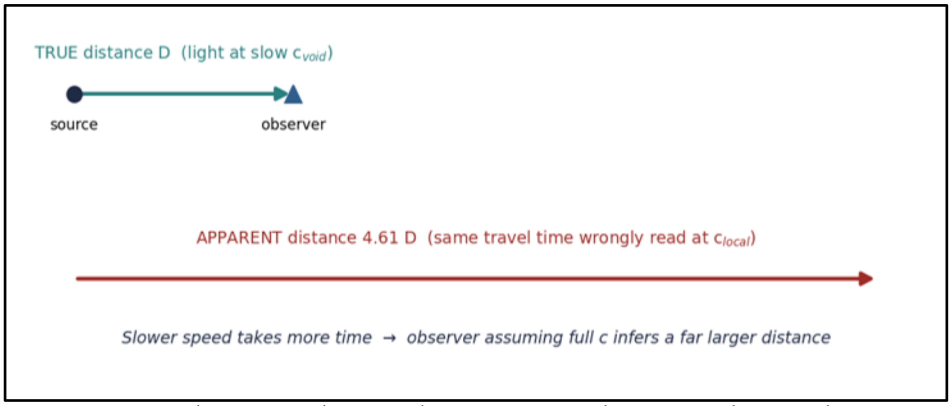
The pattern is clear. The wave theory demanded a medium; the null result of Michelson and Morley (1887) was read as abolishing the medium, and twentieth century physics then promoted the constancy of *c* from a measured fact to a founding postulate. The varying speed of light programme reopened the question but placed the variation almost entirely in cosmic time as a tool against the horizon and flatness problems (Magueijo, 2003). The possibility that *c* varies through space according to the local state of a real medium, here and now, is the gap this paper occupies.

1.3 The IME reframing

The Info-Magneto-Electrostatic framework restores the medium and gives it a constitution. Space is a continuous, compressible, dielectric fluid, the celestial plenum, whose rest density is identified with the permittivity of free space. The plenum is formatted at the smallest scale into a lattice of rhombic dodecahedral information cells, the *Sattvic* grid, and is threaded by a toroidal magnetic field, the Rajasic drive, which tensions the lattice and confines luminous matter, the Tamasic substance, into thin discs. Light is then a transverse mechanical disturbance of this tensioned, formatted fluid, and its speed is a property of the local medium rather than a universal constant. The three names, information, magnetism, and electrostatic plenum, are the three operative energies whose interplay the paper develops.

1.4 Method, voice, and the standard of honesty

The paper grades every substantive claim into one of three classes, following the discipline of the companion studies. A rigorous claim is true of the lattice or the fluid equations, whatever one thinks of the framework. A heuristic claim matches a feature of the model to a physical quantity through a plausible but unproven argument. A



conjecture is a wager that goes beyond present evidence and is tied to a stated test. The reader is invited to accept the rigorous core without accepting every conjecture and to see exactly which measurement would refute each wager. One internal refinement is flagged at the outset and resolved in Section 7.

2. The Hypothesis

Hypothesis H-VSL (variable light speed by medium state). The speed of an electromagnetic disturbance at a point is set by the local mechanical state of the celestial plenum, specifically by the ratio of the local magnetic tension of the plenum web to the local plenum density. The plenum is compressed and strongly tensioned near a rotating body and is relaxed and weakly tensioned far from any rotating body. Consequently light propagates at its terrestrial maximum within the dense, magnetically driven local vortices and propagates more slowly through the low-density, weakly tensioned intergalactic plenum.

Corollary H-SCALE (scale inflation). Because a slower wave takes proportionally more time to traverse a given path, an observer who applies the full local speed c_{local} to the measured travel time of an intergalactic signal overestimates the path length by the ratio c_{local} / c_{void}. The same factor inflates the inferred recession velocity and the inferred Hubble constant. Cosmic distances, the size of the cosmos, and its apparent expansion are therefore partly artefacts of an unrecognised refractive slowdown.

The hypothesis is deliberately the reverse of a naive permittivity argument. If one held only that the void has a lower permittivity ε_0, then the Maxwell relation c =

$1/\sqrt{(\mu_0\varepsilon_0)}$ would predict a faster void, the opposite of what is proposed. Section 3.3 and Section 7 show why the magnetic tension, not the bare density, is the governing stiffness and why the tension falls faster than the density on leaving a rotor so that the net wave speed falls in the void. This result is the decisive physical commitment of the paper, and it is stated as a conjecture awaiting the tests of Section 13.

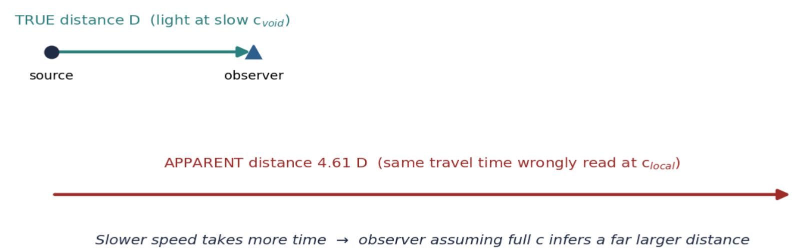


Figure 1. The distance illusion of corollary H-SCALE. The same travel time, read at the full local speed, inflates an intergalactic path length by the factor c_local divided by c_void.

3. The Medium: the Electrostatic Plenum

3.1 Space as a compressible dielectric fluid

The framework rejects empty space. Space is a celestial plenum, a continuous, compressible, viscous, dielectric medium that carries gravitational, inertial, and electromagnetic phenomena alike (Malik, 2026b). The rest density of the plenum is identified with the permittivity of free space, a dimensional identification offered as a heuristic and not yet derived from first principles,

$$\rho_0 \equiv \varepsilon_0 = 8.854 \times 10^{-12} \ \text{F m}^{-1} \quad (1)$$

This is the modern recovery of a thread that runs from Descartes, who filled space with a continuous matter of vortices, through Maxwell, who built the electromagnetic equations on a mechanical sea of vortices and idle wheels, to the later Einstein, who stated that space cannot be thought without physical properties (Descartes, 1983; Maxwell, 1865; Einstein, 1922). The plenum gives that intuition a constitution.

3.2 Fluidic laws and gravity as a pressure gradient

The plenum obeys the conservation laws of a fluid. Continuity conserves plenum mass, and a Euler type relation governs its momentum. A localised rotation, a vortex, lowers the pressure at its core and draws the surrounding medium inward. What classical physics calls the gravitational field is read here as the static pressure gradient of the plenum,

$$\nabla \cdot E_p = \rho_p, \qquad g = -(1/\rho_0)\, \nabla P \quad (2)$$

where E_p is the primordial pressure field and P the plenum pressure. Two bodies are pushed together not by mutual attraction but by the higher undisturbed pressure of the surrounding plenum acting on the low pressure channel between them (Malik, 2026b). The kinematic invariant of any such vortex is the Plenum Influence Parameter, used in Section 6,

$$\Phi = v_{\text{orb}}^2 \cdot r, \qquad g(r) = \Phi / r^2 \quad (3)$$

3.3 Two wave speeds, and which one governs

The plenum supports a transverse disturbance in two complementary descriptions, and the relation between them is the crux of the hypothesis. The electrodynamic description gives the familiar Maxwell speed,

$$c = 1 / \sqrt{(\mu_0 \varepsilon_0)} \quad (4)$$

The mechanical description treats the magnetically threaded plenum as a tensioned elastic web, like a membrane or a string, for which the transverse wave speed is the square root of the restoring tension divided by the mass density,

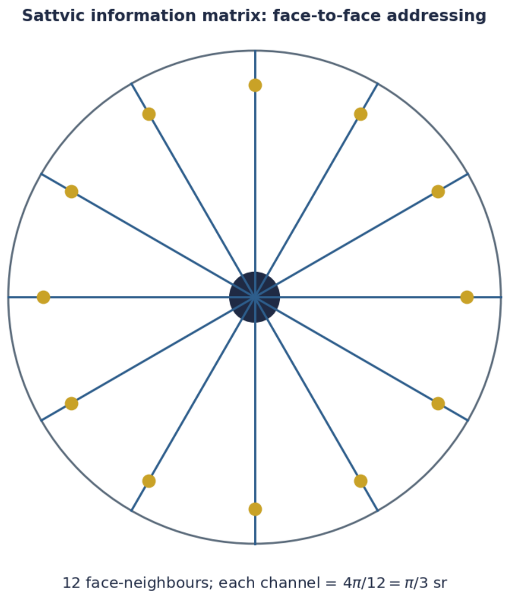
$$c = \sqrt{(T_{\text{mag}} / \rho_{\text{p}})}, \qquad T_{\text{mag}} = B^2 / \mu_0 \quad (5)$$

Here T_{mag} is the magnetic tension supplied by the Rajasic field of magnitude B, which the companion studies describe as the field that tensions the dielectric foam so that a vibrating source can pluck it into a light wave (Malik, 2026c). The two descriptions agree wherever the foam stiffness is set by the magnetic tension. The decisive point is the radial behaviour. Near a rotor the pinch of Section 5 makes B large, so the tension is high and the wave is fast. Far from any rotor the field thins, T_{mag} collapses, and although the density ρ_{p} is also low, the tension is taken to fall faster than the density, so the ratio in equation (5) falls and the wave slows. This is why the governing stiffness is the magnetic tension and not the bare permittivity, and why the void is subluminal rather than superluminal. The claim that the tension falls faster than the density is a conjecture, calibrated empirically in Section 7 and tested in Section 13.

4. The Information Format: the Rhombic Dodecahedral Matrix

The plenum is formatted at the smallest scale into identical cells. The unique cell that fills space without gaps and is also the cell of the densest packing of equal spheres is the rhombic dodecahedron, the Voronoi cell of the face centred cubic lattice whose optimality is the content of the Kepler conjecture proved by Hales (2005). Two rigorous properties matter here. Its twelve rhombic faces meet at the fixed angles

$$\theta_{\text{a}} = \arccos(1/3) \approx 70.53°, \quad \theta_{\text{o}} = \arccos(-1/3) \approx 109.47° \quad (6)$$



and each cell is bonded face to face with exactly twelve neighbours, the kissing number of the lattice. The framework reads the lattice as the addressing structure of space: every information channel has twelve immediate neighbours to which it can hand a state, and no thirteenth. Viewed from the centre of a cell, the twelve faces partition the complete solid angle into twelve equal primary channels,

$$\Omega_{\text{total}} = 4\pi \text{ sr}, \quad \Omega_{\text{face}} = 4\pi / 12 = \pi/3 \text{ sr} \tag{7}$$

Figure 2. The twelve neighbour solid angle partition of a rhombic dodecahedral information cell. Face to face communication proceeds along twelve equal channels of pi over three steradians each.

Face to face communication is the transfer of a disturbance from one cell to a neighbour across a shared face. Because the partition is perfectly symmetric, the medium presents the same structure along every line of sight, and a disturbance launched at one cell propagates as a balanced, twelve-directional front. A photon is, in this picture, not a bullet but a coherent multi cell wave packet. Its modulated volume is approximately a resonant cylinder of length and diameter set by the wavelength λ,

$$V_{\text{photon}} \approx (\pi/4)\, \lambda^3 \tag{8}$$

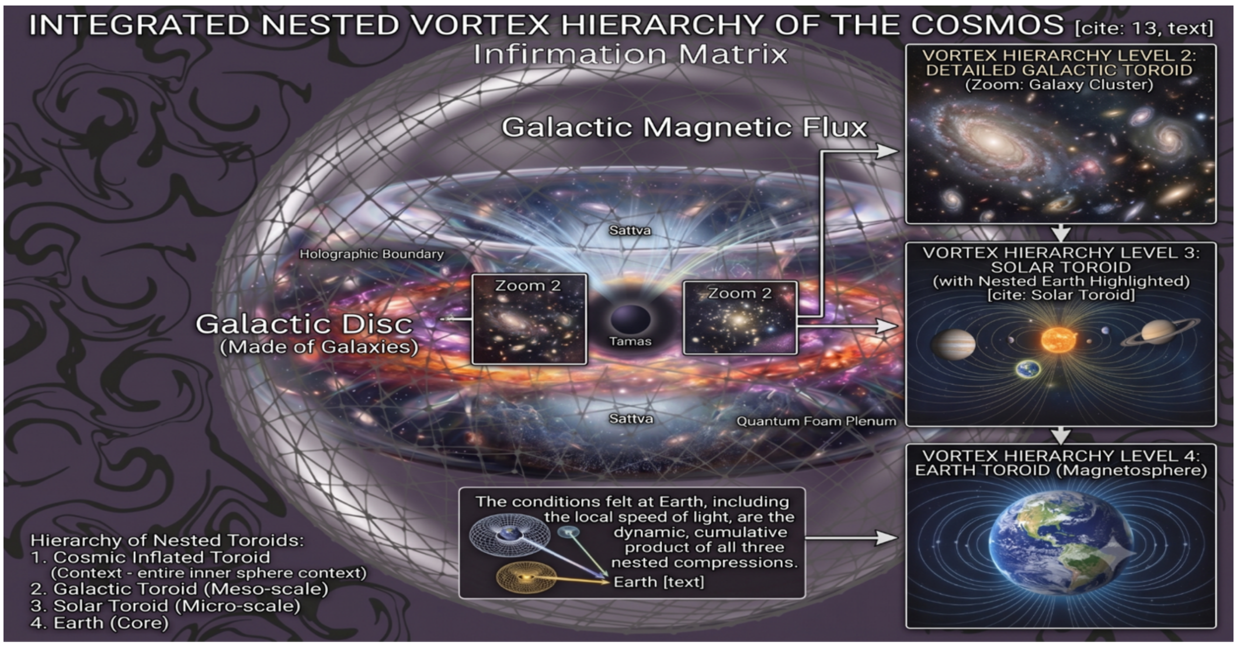
For green light at $\lambda \approx 5 \times 10^{-7}$ m this is about 9.8×10^{-20} m^3, which is of order 1.8×10^{34} base cells. A photon is therefore a macroscopic, beautifully coordinated displacement of the lattice rather than a point object, which is why a single frequency can carry very different energies depending on how tightly its displacement is concentrated (Malik, 2026c).

5. The Magnetic Architecture: Toroid, Pinch, and Tension

The active layer of the cosmos is a toroidal magnetic field, the Rajasic drive. Field lines erupt from the polar cusps of a central rotating stator, loop through deep space, and return through the opposite pole, tracing a torus. Two functions of this torus bear directly on light. First, the torus tensions the plenum web and so sets the wave speed of equation (5). Second, the torus confines luminous matter into a thin disc by a magnetic pinch, the cosmic analogue of the laboratory Z pinch. Equilibrium is reached when the outward expansion pressure of the spinning plenum is balanced by the inward magnetic pressure, the Chakra Confinement Equation,

$$B_z^2 / (2\mu_0) = \tfrac{1}{2}\, \varepsilon_0 \left(\Phi_z / r \right)^2 \tag{9}$$

where B_z is the axial magnetic flux density and Φ_z the axial Plenum Influence Parameter (Malik, 2026a, 2026c). The left side is the magnetic pressure that supplies the tension of equation (5); the right side is the kinetic pressure of the expanding plenum. The same balance that flattens galactic discs and the solar ecliptic also fixes the local stiffness of the medium through which light moves. The magnetic gradient is thus the subtle driving force behind the speed of light: where the gradient is steep, near a rotor, the medium is taut and light is fast; where it relaxes, in the void, the medium is slack and light is slow.



6. The Embedded Vortex Model

The cosmos is not a single rotor but a nest of rotors. Inside the grand cosmic toroid sits a smaller galactic toroid, and inside that a still smaller solar toroid. The Earth lies deep within all three. The medium state at any point, and therefore the local speed of light, is the cumulative product of all three nested compressions. The natural breakpoints of the cascade are the boundaries between rotors: the heliopause between the solar and galactic domains, the galactic boundary between the galactic and cosmic domains, and the cosmic boundary at the edge.

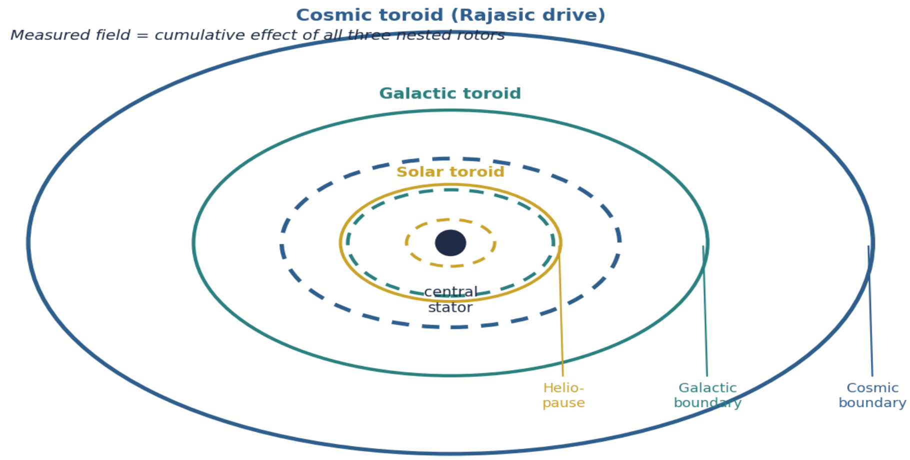


Figure 3. The embedded vortex model. A grand cosmic toroid contains a galactic toroid, which contains a solar toroid. The field measured locally is the cumulative effect of all three, with breakpoints at the heliopause, the galactic boundary, and the cosmic boundary.

The nesting is quantified by the Plenum Influence Parameter of equation (3). Within the Solar System Φ is constant to better than two parts in a thousand across all eight planets, confirming a single coherent vortex (Malik, 2026c). Across scales the parameters of successive rotors follow a quadratic resonance law,

$$\Phi_{\mathrm{Gal}} / \Phi_{\mathrm{Sun}} \approx (\Phi_{\mathrm{Sun}} / \Phi_{\mathrm{Earth}})^2 \quad (10)$$

which holds to within roughly eight to fourteen percent over eleven orders of magnitude of length, with $\Phi_{\mathrm{Earth}} \approx 3.98 \times 10^{14}$, $\Phi_{\mathrm{Sun}} \approx 1.33 \times 10^{20}$, and $\Phi_{\mathrm{Gal}} \approx 1.30 \times 10^{31}$ in units of cubic metres per second squared. The cosmos is thus a self similar hierarchy of nested vortices, and the containment of each rotor inside its host is measured by a step down factor, developed next.

7. Derivation of the Variable Speed of Light

7.1 The containment step down factor

Because omnidirectional plenum pressure decays by the inverse square law, the equilibrium spread of a vortex scales as the inverse square root of the ambient pressure of its host. The step down factor of a contained vortex relative to its uncontained spread is therefore

$$S_d = R_{\mathrm{con}} / R_{\mathrm{un}} = \sqrt{(P_{\mathrm{min}} / P_{\mathrm{ambient}})} \quad (11)$$

Calibration at the stellar tier is direct. The galactic ambient pressure at the orbit of the Sun is about 1.6×10^{-13} Pa and the baseline cosmic pressure calibrated against the cosmic microwave background is about 4.0×10^{-14} Pa, so $S_d = \sqrt{(0.25)} = 0.5$. The observed heliopause near 120 astronomical units then corresponds to an uncompressed solar potential near 240 astronomical units (Malik, 2026c). By the symmetric pressure constraint the same value, one half, is adopted for the galactic tier.

7.2 The local solar strain rate

Before cascading, the local strain rate is computed to show that a Hubble like quantity is a dynamic pressure gradient rather than a flat constant. With the uncompressed solar radius R_{un} = 240 astronomical units ≈ 3.59×10^{10} km,

$$H_{\odot} = c_{\text{local}} / R_{\text{un}} = 299{,}792 / 3.59 \times 10^{10} \approx 8.35 \times 10^{-6} \text{ (km/s)/km} \quad (12)$$

Converted to cosmological units this is about 2.57×10^{14} km s^{-1} Mpc^{-1}, astronomically larger than the gentle cosmic value. The local strain near a stellar engine is enormous, which establishes that the relaxation rate is a decaying gradient, not a universal constant.

7.3 The three tier cascade

Because the wave speed steps down at each nested boundary, the cascade with a step down factor of one half per tier gives the theoretical profile of Table 2.

Tier	Operation	Local speed of light
1. Local space, solar vortex	native maximum	299,792 km/s (1.00 c)
2. Interstellar space, galactic vortex	× 0.5	149,896 km/s (0.50 c)
3. Intergalactic space, cosmic plenum	× 0.5	74,948 km/s (0.25 c)

The cumulative theoretical step down from local space to the deep void is exactly one quarter: light propagates four times more slowly in the cosmic plenum than in the Solar System. This is the qualitative content of hypothesis H-VSL, namely a slower speed in the low density medium.

7.4 The Voyager empirical anchor

The only direct measurements of the medium transition at a vortex boundary come from the Voyager probes crossing the heliopause. Voyager 1 in 2013 and Voyager 2 in 2019 recorded a sharp rise in the in situ electron plasma density on passing from the solar bubble into the interstellar medium, from about 0.002 cm^{-3} in the outer heliosphere to about 0.04 to 0.13 cm^{-3} beyond, a jump of roughly a factor of twenty to fifty (Gurnett et al., 2013; Gurnett and Kurth, 2019). This is the real, published datum.

A point of honesty. The measured thermal plasma density rises outward, whereas the plenum density of the framework is a distinct, postulated quantity, the dielectric foam density, which the framework takes to relax outward. The two must not be conflated. The framework treats the heliopause crossing as the calibration point of the plenum step down and adopts a fluid relaxation factor of 4.61 as a model parameter at this boundary, distinct from the thermal density ratio. Using this factor the intergalactic speed of light is

$$c_{\text{intergalactic}} = 299{,}792 / 4.61 \approx 65{,}030 \text{ km/s} \approx 0.217 \text{ c} \quad (13)$$

The factor 4.61 is therefore a heuristic anchor, not a direct reading of the Voyager density jump, and it is flagged as such in the risk register of Section 14. Figure 4 plots the resulting profile.

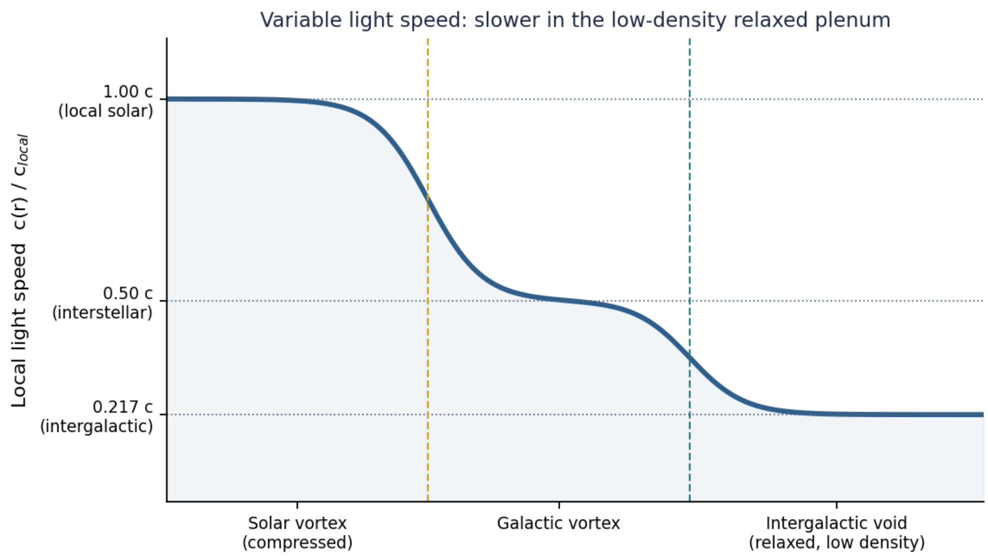


Figure 4. The variable speed of light profile of hypothesis H-VSL. The speed falls in steps from the compressed local solar value through the galactic value to the relaxed intergalactic value, the reverse of a naive permittivity argument.

7.5 Reconciliation with the earlier superluminal treatment

An earlier version of the framework proposed a faster void, near 4.29 c, by lowering the permittivity alone and applying equation (4) (Malik, 2026c). The companion geometric study already flagged that superluminal void index as a conjecture to be read as a statement about the refractive index of an unreachable reference medium, bounded by stringent Lorentz invariance data, and not as a usable faster than light signal (Malik, 2026a). The present paper supersedes that sign. Under hypothesis H-VSL the governing stiffness is the magnetic tension of equation (5), which collapses in the void, so the void is subluminal. The refinement matters because only the subluminal version produces the distance overestimate of corollary H-SCALE and therefore the resolution of the next section.

8. Cosmic Scale Measurement

8.1 Apparent against true distance

An intergalactic signal travels at c_{void} but is interpreted at c_{local}. The inferred distance exceeds the true distance by the inflation factor

$$D_{apparent} \;/\; D_{true} \;=\; c_{local} \;/\; c_{void} \;\approx\; 4.61(14)$$

Every purely intergalactic distance is therefore overestimated by about a factor of five under this hypothesis. The overestimate is the quantitative form of reading slowness as distance.

8.2 The true and the observed Hubble constant

The Hubble constant is a relaxation rate, the speed of light divided by a horizon scale. Using the true intergalactic speed against the mass boundary $R_{28\%} \approx 4567$ Mpc gives the true relaxation rate

$$H_{\text{true}} = c_{\text{intergalactic}} / R_{28\%} = 65{,}030 / 4567 \approx 14.24 \text{ km s}^{-1} \text{ Mpc}^{-1} \quad (15)$$

Earthbound instruments multiply their redshift data by the local rather than the intergalactic speed, inflating the result by the same Voyager factor,

$$H_{\text{observed}} = H_{\text{true}} \times 4.61 = 14.24 \times 4.61 \approx 65.6 \text{ km s}^{-1} \text{ Mpc}^{-1} \quad (16)$$

Equivalently $H_{\text{observed}} = c_{\text{local}} / R_{28\%} = 299{,}792 / 4567 \approx 65.6$, since the two factors of 4.61 cancel. The predicted observed value near 65.6 km s^{-1} Mpc^{-1} sits beside the early universe Planck value of 67.4 km s^{-1} Mpc^{-1} (Planck Collaboration, 2020). Table 3 places the framework value against the two standard measurements that define the Hubble tension.

Determination	H0 (km/s/Mpc)	Reading in this framework
Planck 2018 CMB (Planck Collaboration, 2020)	67.4 ± 0.5	early universe relaxation rate
SH0ES local distance ladder (Riess et al., 2022)	73.04 ± 1.04	biased high by local vortex compression and bulk flow
IME refractive derivation (this paper)	≈ 65.6	c_local divided by the mass boundary R_28%

In this reading, the tension between the two standard determinations (Di Valentino et al., 2021) is not a defect of measurement but a signature of two different light speeds applied to two different probes: the early universe horizon and the local ladder. The interpretation is offered as a conjecture, and its decisive test is given in Section 13.

8.3 The apparent radius of the observable cosmos

The same logic addresses the apparent radius of the observable cosmos, conventionally about 46 billion light years. Part of the excess over any finite physical container is attributed to the speed correction of equation (14) and part to a multi bounce optical path within a closed, magnetically guided chamber, in which oblique light is bent along the toroidal canopy and recycled rather than escaping (Malik, 2026c). Both elements are conjectural and are listed in the risk register. The robust claim is narrower: if the intergalactic speed is below the local speed, then the conventional radius is an overestimate, and the true container is smaller than it appears.

9. Light Distribution and the Inverse Square Law

The fall of intensity with distance is derived on the lattice as a counting theorem rather than assumed. A disturbance seeded at one cell advances by hops across shared faces. After k hops the active front occupies a shell whose number of outward transfer faces grows as the square of k, and the conserved initial strength is divided among them,

$$N(k) \propto k^2, \qquad A(k) = A_0 \,/\, N(k) \propto 1 \,/\, k^2 \quad (17)$$

The exponent two is fixed by the three dimensionality of space, not fitted. The inverse square fall of light, of static fields, and of the plenum pressure gradient read as gravity all share this single counting origin. Table 4 compares the lattice counting result with the continuum inverse square law; they agree to the precision shown, and the discrete deviation is negligible at macroscopic distance.

Distance (units)	Relative intensity 1/r^2	IME face count amplitude
1	1.0000	1.0000 (one transfer face)
2	0.2500	0.2500 (four transfer faces)
3	0.1111	0.1111 (nine transfer faces)
5	0.0400	0.0400 (twenty five transfer faces)
10	0.0100	0.0100 (one hundred transfer faces)

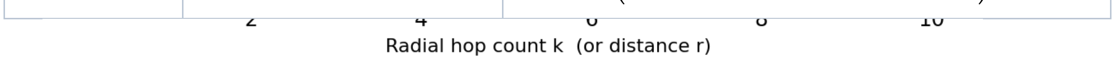


Figure 5. The inverse square law as a face counting theorem. The number of outward transfer faces grows as k squared, so the amplitude per face falls as one over k squared, matching the continuum law.

10. The Interplay of the Three Energies

The framework names three operative energies, and their interplay governs how a signal is impressed on the medium and read out at a receiver. In order of increasing subtlety they are the information field, the magnetic field, and the dense plenum foam. The most subtle is information, then magnetism, and then the foam. In its own domain each plays the lead and the others support.

Energy (Guna)	Role	Mode of action on light
Information (Sattva)	geometric format, most subtle	fixes the lattice, the addressing channels, and the inverse square exponent
Magnetism (Rajas)	active drive and tension	tensions the web and sets the local wave speed by equation (5)
Plenum foam (Tamas)	dense substance, the carrier	the medium that is physically displaced; carries the disturbance

Communication across this medium follows the same grammar as a radio link. The source disturbs the medium; the signature of the disturbance is its frequency, and the strength of the disturbance is its amplitude. What a receiver detects is the modulation riding on a carrier. Gravity is read as a very low frequency carrier, the slow bulk pressure gradient, and light as a higher frequency modulation impressed on the same medium. The transfer is face to face along the twelve channels of Figure 2, which is why the medium can carry both the slow gravitational carrier and the fast luminous modulation without one erasing the other.

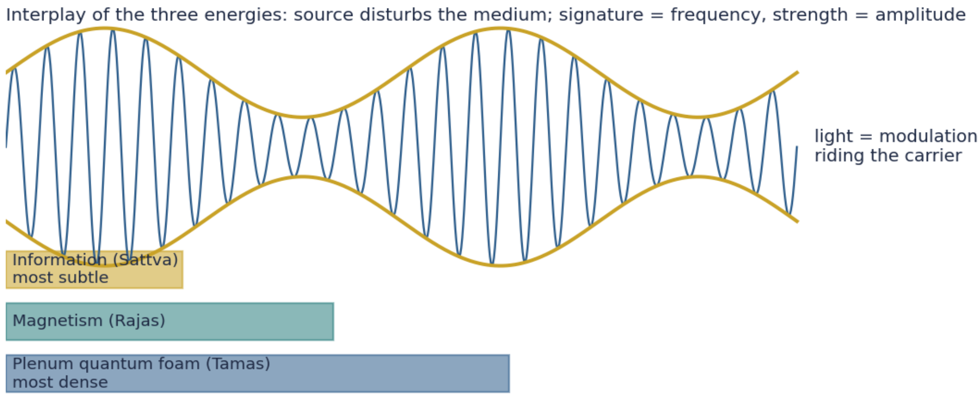


Figure 6. The carrier and modulation picture. The dominance hierarchy of the three energies is shown by the bars; light is the modulation envelope riding on the carrier of the medium, with frequency as signature and amplitude as strength.

11. High Vortex Regions: Stars, Dark Stars, and Quasars

Where the vortex is intense, both the plenum foam, the Tamasic substance, and the magnetism, the Rajasic drive, are high. The magnetic gradient of a star is the subtle driving force that tensions the surrounding medium, which is precisely why the region around a star is luminous and why one can see structure around it. The behaviour at the extremes of vortex strength follows directly from equation (5).

- **A star.** The strong magnetic gradient keeps the surrounding medium taut, so light propagates efficiently and the neighbourhood of the star is visible. An observer standing on the surface of a star, however, sits inside the most compressed and turbulent part of the local vortex, where a light disturbance arriving from a source on the far side must cross the high impedance core; such an observer may receive little or no light from the opposite source.
- **A dark star.** At the limit of compression the foam loses its elasticity, the local tension to density ratio collapses toward zero, and the wave speed approaches zero. A light packet meeting such a boundary is not captured by a mysterious pull but is mechanically decimated: the front halts while the rear advances, and the disturbance is flattened and absorbed into the core. The object looks black because incoming disturbances are extinguished, not because they are swallowed whole (Malik, 2026c).
- **A hyperluminous quasar.** An object such as the quasar TON 618 carries so

intense a vortex that its own emission saturates the surrounding medium. The local foam is driven so hard that little contrast remains for fainter neighbouring sources, so one cannot see much around it. The same magnetic gradient that makes a modest star a clear window makes an extreme quasar a glare.

The unifying statement is that visibility around a body is governed by the local magnetic gradient. A moderate gradient yields a taut, transparent medium and a clear view; a vanishing gradient yields a dead, opaque medium; an overwhelming gradient yields a saturated, glaring medium.

12. Real World Comparisons and Supporting Data

The hypothesis stands or falls on data. Table 5 collects the strongest real world anchors and the points of tension, drawn from published measurements. The single most direct support for the central mechanism is that the speed of light is already known to depend on the medium.

Observation	What is measured	Bearing on H-VSL
Slow light in cold matter (Hau et al., 1999)	group speed of light reduced to 17 m/s in a Bose Einstein condensate; about 30 percent reduction in glass	supports: light speed is set by the medium
Voyager heliopause crossing (Gurnett and Kurth, 2019)	in situ density jump of factor twenty to fifty at a vortex boundary	anchors a real medium transition at a rotor boundary
Hubble tension (Planck Collaboration, 2020; Riess et al., 2022)	67.4 against 73.0 km/s/Mpc by two methods	matched by one refractive correction, Section 8
Closed universe preference (Di Valentino et al., 2020; Handley, 2021)	Planck lensing favours positive curvature	consistent with a finite, bounded cosmos
Cosmic filament spin (Wang et al., 2021)	coherent rotation of filaments tens of Mly long	consistent with a toroidal magnetic drive
VSL programme (Magueijo, 2003; Moffat, 2016)	varying c as an alternative to inflation	precedent for a non constant c, here spatial not temporal
Supernova time dilation (White et al., 2024)	light curve width proportional to (1+z), b = 1.003 ± 0.005	tension: see Section 13, the decisive test

The Hau et al. (1999) result is the proof of principle: a beam of light slowed from about 3×10^8 m/s to 17 m/s simply by passing through a particular medium, a reduction by a factor of about twenty million, with the same physics by which ordinary glass slows light by roughly thirty percent. That light speed is a property of the medium is therefore not in dispute. The framework extends this established fact from the laboratory to the cosmic medium and asserts that the relevant medium parameter varies with proximity to a rotor.

13. Falsification Criteria and Proposed Experiments

The value of the hypothesis rests on its refutability. The following criteria are stated precisely enough to be decided by current or near future instruments, and the decisive challenge is named first and not evaded.

13.1 The decisive test: supernova time dilation

If cosmological redshift is a refractive deceleration rather than a kinematic expansion, then there is no obvious reason for the light curves of distant standard candles to be stretched in time by the factor $(1 + z)$. Yet the time stretching is observed, robustly. Goldhaber et al. (2001) found the light curve width proportional to $(1 + z)$; Blondin et al. (2008) confirmed it from spectral ageing; and White et al. (2024), using 1504 Type Ia supernovae from the Dark Energy Survey to redshift near unity, found the stretch exponent $b = 1.003 \pm 0.005$, ruling out non time dilating models at very high significance. The classic tired light hypothesis (Zwicky, 1929) and static models are disfavoured by exactly this evidence, as are hybrid models that still struggle with it (Gupta, 2023).

Falsification criterion F1. Hypothesis H-VSL is refuted unless its refractive mechanism produces an apparent $(1 + z)$ stretching of distant transient light curves of the magnitude observed. A pure slowdown without a compensating time mechanism predicts no stretch and is therefore already in tension with White et al. (2024). The framework must derive the stretch from its own variable time tape, in which the rate of processing of the medium scales with the local permittivity, or be abandoned. This is stated as the primary open problem of the paper.

13.2 Further criteria

No.	Prediction or criterion	Test method
F2	The measured Hubble constant is anisotropic, varying by roughly 3 to 5 percent between the CMB dipole direction and its antipode	Type Ia surveys, Rubin Observatory and Roman
F3	The Tolman surface brightness test favours expansion at the level already reported	surface brightness against redshift for early type galaxies (Lubin and Sandage, 2001)
F4	Frequency dependent dispersion residuals beyond the geometric Shapiro delay appear in deep space tracking during solar conjunction	precise transponder tracking of deep space probes
F5	Deep surveys reveal periodic redshift shells at harmonics of the cosmic radius if the boundary is a specular mirror	ultra deep redshift surveys, Euclid and DESI beyond redshift 3
F6	The large scale magnetic drive has a golden ratio	Faraday rotation mapping

No.	Prediction or criterion	Test method
	aspect, major to minor radius approaching phi	of cosmic magnetic topology

Criteria F2 through F6 are supportive or exploratory. Criterion F1 is decisive: the framework either accounts for the observed (1 + z) time stretching of supernova light curves or it is falsified.

14. Discussion

14.1 Relationship to established physics

The framework is a reinterpretation rather than a wholesale rejection of validated results. For an observer co-moving with the local plenum the speed of light is invariant, preserving the success of special relativity in the laboratory; variation appears only across large density gradients between rotors, where no terrestrial experiment has tested it. The kinematic Plenum Influence Parameter reproduces Newtonian orbital predictions. The departure is interpretive: where the standard model attributes redshift to metric expansion, the framework attributes it to refractive deceleration in a real medium, and where the standard model invokes dark energy, the framework invokes the relaxation of plenum tension.

14.2 Risk register

Each substantive claim is graded so that the rigorous core can be separated from the wagers.

Claim	Grade	Basis and remaining work
Light speed depends on the medium	Rigorous	established; Hau et al. (1999)
Inverse square law as a k squared face count	Rigorous given the lattice	counting theorem; identification with physical fields is the claim
Twelve neighbour partition of the solid angle	Rigorous	kissing number of the lattice; Hales (2005)
Plenum density identified with permittivity	Heuristic	dimensionally suggestive; not yet first principles
Magnetic tension governs the wave speed, slower in void	Conjecture	the central commitment; tested by F1 through F4
Voyager relaxation factor 4.61	Heuristic	model anchor, distinct from the thermal density jump
Refractive resolution of the Hubble tension	Conjecture	matches the numbers; must pass F1
Multi bounce apparent radius near 46	Conjecture	beyond present evidence;

Claim	Grade	Basis and remaining work
Gly		geometric core does not depend on it

14.3 Open problems

1. The time dilation of distant supernova light curves must be derived from the variable time tape of the medium, or hypothesis H-VSL fails criterion F1.
2. The identification of plenum density with permittivity, and the claim that magnetic tension falls faster than density in the void, both await derivation from a single constitutive law of the plenum.
3. The intergalactic speed depends on a step down factor anchored at one boundary; an independent calibration at a second boundary is needed to remove the reliance on the symmetric pressure constraint.

15. Summary

This paper proposed and developed a position dependent speed of light within the Info-Magneto-Electrostatic framework. Space was treated as a real, compressible, dielectric plenum, formatted into a rhombic dodecahedral information lattice and tensioned by a toroidal magnetic drive. The speed of a light disturbance was set by the ratio of magnetic tension to plenum density, so that light is fast in the compressed, strongly driven local vortices and slow in the relaxed, weakly driven intergalactic void. The cosmos was modelled as embedded rotors, cosmic within galactic within solar, whose cumulative step downs define the local medium state, with breakpoints at the heliopause, the galactic boundary, and the cosmic boundary.

A three tier cascade with a step down factor of one half per tier, anchored at the Voyager heliopause crossing through a relaxation factor of 4.61, gave an intergalactic speed near 65,000 km/s, about 0.217 of the local value. Applied to scale measurement, the single correction reproduced the gap between the local and early universe Hubble constants and recast cosmological redshift as refractive deceleration. The inverse square distribution of light was derived as a face counting theorem with the exponent fixed by three dimensionality. The roles of information, magnetism, and the plenum foam were set out as a carrier and modulation hierarchy, and the behaviour of light near stars, dark stars, and the brightest quasars was explained by the local magnetic gradient. The decisive falsification criterion, the observed time stretching of distant supernova light curves, was named openly as the test the framework must pass.

16. Conclusion

Cosmic distance is read from travel time, and travel time depends on a speed that physics has, for a century, assumed to be universal. The present work argued that this assumption is the hidden source of the apparent vastness, rapid expansion, and unresolved tensions of the standard cosmological picture. If light is a mechanical disturbance of a real, magnetically tensioned medium, then it must slow where that medium relaxes, in the sparse intergalactic void far from any rotor, and a slower signal read at full local speed is mistaken for a distant one. The established fact that light slows in a laboratory medium gives the mechanism a concrete precedent; the embedded vortex architecture gives it a cosmic structure; and the Voyager crossing of the heliopause gives it an empirical anchor.

The framework reproduces the Hubble tension as a refractive artefact, derives the inverse square law from the format of space itself, and explains the visibility of stars, the darkness of dark stars, and the glare of the brightest quasars by one quantity, the local magnetic gradient. These results are offered with their grades attached, the rigorous separated from the heuristic and the conjectural, and tied to specific measurements that could prove them wrong. The single measurement that the framework must still meet is the time dilation of distant supernovae. The ancient intuition that space is a plenum rather than a void, carried from the Vaisheshika and Samkhya schools through Descartes and the later Einstein, is here put in a form precise enough to be measured, and submitted without reservation to the instruments that could refute it.

Acknowledgements

The author acknowledges the philosophical lineage of the Samkhya and Vaisheshika schools as foundational sources for the ontological framework, the geometric tradition from Plato and Kepler to the modern lattice theorists, and the observational programmes of NASA, the European Space Agency, and the international cosmic flows and radio astronomy collaborations whose data provide the empirical anchors for this work. No external funding was received. The author declares no competing interests.

References

Albrecht, A., & Magueijo, J. (1999). A time varying speed of light as a solution to cosmological puzzles. Physical Review D, 59(4), Article 043516. https://doi.org/10.1103/PhysRevD.59.043516

Barrow, J. D. (1999). Cosmologies with varying light speed. Physical Review D, 59(4), Article 043515. https://doi.org/10.1103/PhysRevD.59.043515

Blondin, S., Davis, T. M., Krisciunas, K., Schmidt, B. P., Sollerman, J., Spyromilio, J., & Tonry, J. L. (2008). Time dilation in Type Ia supernova spectra at high redshift. The Astrophysical Journal, 682(2), 724 to 736. https://doi.org/10.1086/589568

Descartes, R. (1983). Principles of philosophy (V. R. Miller & R. P. Miller, Trans.). Reidel. (Original work published 1644)

Di Valentino, E., Melchiorri, A., & Silk, J. (2020). Planck evidence for a closed universe and a possible crisis for cosmology. Nature Astronomy, 4(2), 196 to 203. https://doi.org/10.1038/s41550-019-0906-9

Di Valentino, E., Mena, O., Pan, S., Visinelli, L., Yang, W., Melchiorri, A., Mota, D. F., Riess, A. G., & Silk, J. (2021). In the realm of the Hubble tension: A review of solutions. Classical and Quantum Gravity, 38(15), Article 153001. https://doi.org/10.1088/1361-6382/ac086d

Einstein, A. (1922). Sidelights on relativity (G. B. Jeffery & W. Perrett, Trans.). Methuen. (Address on ether and the theory of relativity delivered 1920)

Goldhaber, G., Groom, D. E., Kim, A., Aldering, G., Astier, P., Conley, A., & Perlmutter, S. (2001). Timescale stretch parameterization of Type Ia supernova B-band light curves. The

Astrophysical Journal, 558(1), 359 to 368. https://doi.org/10.1086/322460

Gupta, R. P. (2023). JWST early Universe observations and Lambda CDM cosmology. Monthly Notices of the Royal Astronomical Society, 524(3), 3385 to 3395. https://doi.org/10.1093/mnras/stad2032

Gurnett, D. A., & Kurth, W. S. (2019). Plasma densities near and beyond the heliopause from the Voyager 1 and 2 plasma wave instruments. Nature Astronomy, 3(11), 1024 to 1028. https://doi.org/10.1038/s41550-019-0918-5

Gurnett, D. A., Kurth, W. S., Burlaga, L. F., & Ness, N. F. (2013). In situ observations of interstellar plasma with Voyager 1. Science, 341(6153), 1489 to 1492. https://doi.org/10.1126/science.1241681

Hales, T. C. (2005). A proof of the Kepler conjecture. Annals of Mathematics, 162(3), 1065 to 1185. https://doi.org/10.4007/annals.2005.162.1065

Handley, W. (2021). Curvature tension: Evidence for a closed universe. Physical Review D, 103(4), Article L041301. https://doi.org/10.1103/PhysRevD.103.L041301

Hau, L. V., Harris, S. E., Dutton, Z., & Behroozi, C. H. (1999). Light speed reduction to 17 metres per second in an ultracold atomic gas. Nature, 397(6720), 594 to 598. https://doi.org/10.1038/17561

Huygens, C. (1912). Treatise on light (S. P. Thompson, Trans.). Macmillan. (Original work published 1690)

Magueijo, J. (2003). New varying speed of light theories. Reports on Progress in Physics, 66(11), 2025 to 2068. https://doi.org/10.1088/0034-4885/66/11/R04

Malik, S. S. (2026a). Information geometry of the IME cosmos: The rhombic dodecahedral plenum, the harmonic constants, and the finite toroidal architecture of a formatted cosmos [Manuscript]. Independent research in foundations of physics.

Malik, S. S. (2026b). Celestial plenum dynamics: The fabric and dynamics of the Info-Magneto-Electrostatic cosmos [Manuscript]. Independent research in foundations of physics.

Malik, S. S. (2026c). The shape of the cosmos: A tridoshic electrodynamic architecture of the toroidal universe [Manuscript]. Independent research in foundations of physics.

Maxwell, J. C. (1865). A dynamical theory of the electromagnetic field. Philosophical Transactions of the Royal Society of London, 155, 459 to 512. https://doi.org/10.1098/rstl.1865.0008

Michelson, A. A., & Morley, E. W. (1887). On the relative motion of the Earth and the luminiferous ether. American Journal of Science, 34(203), 333 to 345. https://doi.org/10.2475/ajs.s3-34.203.333

Moffat, J. W. (1993). Superluminary universe: A possible solution to the initial value problem in cosmology. International Journal of Modern Physics D, 2(3), 351 to 365. https://doi.org/10.1142/S0218271893000246

Moffat, J. W. (2016). Variable speed of light cosmology, primordial fluctuations and gravitational waves. The European Physical Journal C, 76(3), Article 130. https://doi.org/10.1140/epjc/s10052-016-3971-6

Newton, I. (1952). Opticks: Or, a treatise of the reflections, refractions, inflections and colours of light. Dover. (Original work published 1704)

Parker, E. N. (1958). Dynamics of the interplanetary gas and magnetic fields. The Astrophysical Journal, 128, 664 to 676. https://doi.org/10.1086/146579

Planck Collaboration. (2020). Planck 2018 results. VI. Cosmological parameters. Astronomy and Astrophysics, 641, Article A6. https://doi.org/10.1051/0004-6361/201833910

Plato. (2000). Timaeus (D. J. Zeyl, Trans.). Hackett. (Original work composed c. 360 BCE)

Riess, A. G., Yuan, W., Macri, L. M., Scolnic, D., Brout, D., Casertano, S., & Zheng, W. (2022). A comprehensive measurement of the local value of the Hubble constant with 1 km/s/Mpc uncertainty from the Hubble Space Telescope and the SH0ES team. The Astrophysical Journal Letters, 934(1), Article L7. https://doi.org/10.3847/2041-8213/ac5c5b

Wang, P., Libeskind, N. I., Tempel, E., Kang, X., & Guo, Q. (2021). Possible observational evidence for cosmic filament spin. Nature Astronomy, 5(8), 839 to 845. https://doi.org/10.1038/s41550-021-01380-6

White, R. M. T., Davis, T. M., Lewis, G. F., Brout, D., Galbany, L., Glazebrook, K., & Wiseman, P. (2024). The Dark Energy Survey Supernova Program: Slow supernovae show cosmological time dilation out to redshift near one. Monthly Notices of the Royal Astronomical Society, 533(3), 3365 to 3378. https://doi.org/10.1093/mnras/stae2008

Zwicky, F. (1929). On the red shift of spectral lines through interstellar space. Proceedings of the National Academy of Sciences, 15(10), 773 to 779.

https://doi.org/10.1073/pnas.15.10.773

Appendix A

Glossary of Framework Terms

Term	Meaning in this framework
Celestial plenum	the compressible dielectric medium that fills all space
Sattva (information)	the geometric format; the rhombic dodecahedral lattice and its laws
Rajas (magnetism)	the toroidal magnetic drive that tensions the plenum and confines matter
Tamas (plenum foam)	the dense substance that is physically displaced as light
Plenum Influence Parameter	the kinematic vortex invariant Phi = v squared times r
Step down factor	the containment ratio of a vortex inside its host, equation (11)
Embedded vortex model	nested rotors, cosmic within galactic within solar
Chakra Confinement Equation	the magnetic pinch balance, equation (9)
Magnetic tension	B squared over mu zero; the stiffness that sets the wave speed