Bridge Narrative

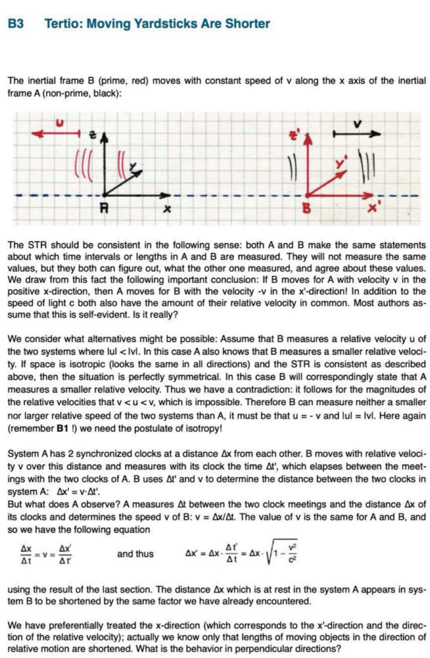
Purpose. This narrative walks the Bridge step-by-step. No flux talk, no imported force axioms, we don't even import or assume mass or energy. It explains what the math is doing in real terms so readers can follow the sequence without the derivations in front of them.

Stage-setting — Why Voids and why Display Area (A_d)

In almost every physic class you see something like this below. I took a photo of this one, he used an original copy of Einstein's. Teachers show the math and always talk about how the the object gets skinnier as it approaches the speed of light. But the book also says and shows the "shadow grows". It is right there in every book, and the corner stone of our Theory. They **never name it, never use it**, and never promote it to a state variable. It's been there the whole time!

"What is the behavior in perpendicular directions?" — Epstein, Relativity Visualized

Figure 1: Relativistic length contraction. Figure 2: Geometric depiction of contraction and unchanged transverse axes.



B3 Tertio: Moving Yardsticks Are Shorter

The inertial frame B (prime, red) moves with constant speed of v along the x axis of the inertial frame A (non-prime, black):

The STR should be consistent in the following sense: both A and B make the same statements about which time intervals or lengths in A and B are measured. They will not measure the same values, but they both can figure out, what the other one measured, and agree about these values. We draw from this fact the following important conclusion: If B moves for A with velocity v in the positive x-direction, then A moves for B with the velocity -v in the x'-direction! In addition to the speed of light c both also have the amount of their relative velocity in common. Most authors assume that this is self-evident. Is it really?

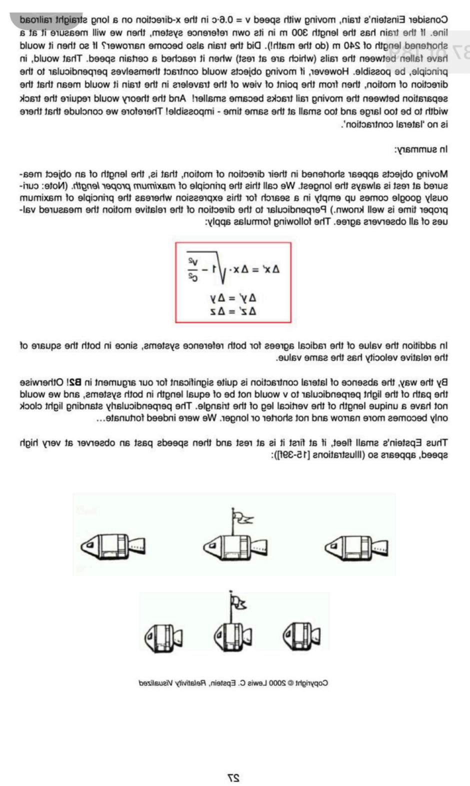
We consider what alternatives might be possible: Assume that B measures a relative velocity u of the two systems where $|u| < |v|$. In this case A also knows that B measures a smaller relative velocity. If space is isotropic (looks the same in all directions) and the STR is consistent as described above, then the situation is perfectly symmetrical. In this case B will correspondingly state that A measures a smaller relative velocity. Thus we have a contradiction: it follows for the magnitudes of the relative velocities that $v < u < v$, which is impossible. Therefore B can measure neither a smaller nor larger relative speed of the two systems than A, it must be that $u = - v$ and $|u| = |v|$. Here again (remember **B1** !) we need the postulate of isotropy!

System A has 2 synchronized clocks at a distance Δx from each other. B moves with relative velocity v over this distance and measures with its clock the time $\Delta t'$, which elapses between the meetings with the two clocks of A. B uses $\Delta t'$ and v to determine the distance between the two clocks in system A: $\Delta x' = v \cdot \Delta t'$.
But what does A observe? A measures Δt between the two clock meetings and the distance Δx of its clocks and determines the speed v of B: $v = \Delta x / \Delta t$. The value of v is the same for A and B, and so we have the following equation

$$\frac{\Delta x}{\Delta t} = v = \frac{\Delta x'}{\Delta t'} \qquad \text{and thus} \qquad \Delta x' = \Delta x \cdot \frac{\Delta t'}{\Delta t} = \Delta x \cdot \sqrt{1 - \frac{v^2}{c^2}}$$

using the result of the last section. The distance Δx which is at rest in the system A appears in system B to be shortened by the same factor we have already encountered.

We have preferentially treated the x-direction (which corresponds to the x'-direction and the direction of the relative velocity); actually we know only that lengths of moving objects in the direction of relative motion are shortened. What is the behavior in perpendicular directions?



Consider Einstein's train, moving with speed $v = 0.6 \cdot c$ in the x-direction on a long straight railroad line. If the train has the length 300 m in its own reference system, then we will measure it at a shortened length of 240 m (do the math!). Did the train also become narrower? If so then it would have fallen between the rails (which are at rest) when it reached a certain speed. That would, in principle, be possible. However, if moving objects would contract themselves perpendicular to the direction of motion, then from the point of view of the travelers in the train it would mean that the separation between the moving rail tracks became smaller! And the theory would require the track width to be too large and too small at the same time - impossible! Therefore we conclude that there is no 'lateral contraction'.

In summary:

Moving objects appear shortened in their direction of motion, that is, the length of an object measured at rest is always the longest. We call this the principle of maximum proper length. (Note: curiously google comes up empty in a search for this expression whereas the principle of maximum proper time is well known.) Perpendicular to the direction of the relative motion the measured values of all observers agree. The following formulas apply:

$$\Delta x' = \Delta x \cdot \sqrt{1 - \frac{v^2}{c^2}}$$
$$\Delta y' = \Delta y$$
$$\Delta z' = \Delta z$$

In addition the value of the radical agrees for both reference systems, since in both the square of the relative velocity has the same value.

By the way, the absence of lateral contraction is quite significant for our argument in **B2**! Otherwise the path of the light perpendicular to v would not be of equal length in both systems, and we would not have a unique length of the vertical leg of the triangle. The perpendicularly standing light clock only becomes more narrow and not shorter or longer. We were indeed fortunate...

Thus Epstein's small fleet, if at first it is at rest and then speeds past an observer at very high speed, appears so (Illustrations [15-39f]):

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Lorentz Contraction: $\Delta x' = \Delta x \cdot \sqrt{(1 - v^2/c^2)}$ $y\Delta = y\Delta$ $z\Delta = z\Delta$	$A\perp=(y\Delta)(z\Delta)$ $y\Delta$ times $z\Delta$ equates to the VMS display-area.	$$A_\perp = y\Delta \cdot z\Delta \quad \text{(invariant)}$$ $$x\Delta \to \frac{x\Delta}{\gamma}$$ $$\Rightarrow \quad \text{Apparent transverse dominance increases by } \gamma$$

It's just geometry, but in VMS, that **transverse persistence** is not just geometry — it becomes the **display-area**, which **enters energy and closure terms.**

Reference:

Epstein, L. C. (1985). Relativity Visualized. Insight Press. Reprint 2000 edition available via relativity.

The Minimal Statement sets the stage: reality tolerates moving boundaries. I name that boundary a Void — a propagating absence that advances at c. As it moves, it hides a transverse patch of space. That hidden patch is the Display Area A_d. I pick A_d on purpose: geometry survives every argument about words. If you can count what gets hidden as routes move, you can compare routes without guessing new substances.

• We speak in projected display area:A_d = πr^2. No double-counting. Unit hygiene is explicit.

• We carry a single dimensional scale ($S_0 = \hbar$)

• One units-bearing knob. In the whole framework, the only new quantity with units we introduce is an action scale S_0. We fix it to Planck's reduced constant ħ (CODATA value) to lock to SI units and never tune it. Everything else is geometry (routes, display area A_d) or previously locked constants (like c, G).
• Why action? Our bookkeeping accumulates a route "cost" S (an action). To turn that into a physical phase, we use:

$$\varphi = S / S_0$$

Choosing $S_0 = \hbar$ makes phases dimensionless and immediately lands the familiar wave labels.
• What drops out (no extra postulates). Once $\varphi = S / \hbar$, the standard identities are just bookkeeping:

$$k = 2\pi/\lambda, \quad \omega = c\ k, \quad E = \hbar\ \omega, \quad p = \hbar\ k$$

We didn't assume quantum rules; they appear because we convert our geometric action to phase with S_0.
• Why only one scale? Using a single, fixed S_0 prevents hidden dials. The same scale links open paths (waves/photons), closed loops (mass/inertia), and timing (clock shifts), so ratios and absolute predictions live on one yardstick—no per-experiment retunes.
So, when you see "We carry a single dimensional scale $S_0 = \hbar$" and you will see it everywhere that's what it means.

Foundational carry-over (not re-argued)

• A1 — Void: smooth moving boundary, travels at c, hides a transverse patch each step.

• A2 — Space: finite length/area; finite, non-zero tension; deformations propagate at c; curvature and caustics are allowed.

• A3 — Expansion: orientation is preserved; handedness survives transport.

From here on I work with routes, closure, and the Display Area they hide as they move.

Step 1 — Display Area → Display Action (how we measure routes)

At each step along any route, take the orthographic patch hidden right now: A_d. Accumulate it along the route: that integral is the action for that route. At this stage only ratios matter — which route hides less (cleaner) versus more (costlier). Curving a path changes how A_d grows. In this bookkeeping, torsion and curvature are not metaphors; they are how the hidden patch evolves as the route bends and twists.

— Takeaway: A_d is the single bookkeeping move that lets waves, mass, and forces share one language.

Students are often taught two different pictures of light. In classical physics, light is an electromagnetic wave with both a wavelength (length) and an amplitude (height). In quantum physics, however, the photon is treated as a point like particle that retains its wavelength but loses any clear geometric height or width. Amplitude becomes only a probability amplitude in the wavefunction. This creates a conceptual gap: why does light retain a length but lose its other dimensions?

Classical Physics

- Wavelength is a real, measurable physical length.
- Amplitude is the height of the electric field oscillation, measurable as intensity.
- Together, the wave has both a length scale and a 'height.'

Quantum / Standard Model

- Photon is modeled as a point particle with no size.
- Wavelength is still preserved, tied to energy and momentum.
- Amplitude is no longer geometric, only a probability amplitude.
- Geometry seems to collapse into a single dimension.

VMS Reframing

In VMS, the photon (or void) is restored as a basic geometric entity. It does not collapse to a point with only wavelength; instead, it carries a true display-area footprint. Wavelength is preserved exactly as in classical and quantum treatments, but the 'missing dimensions' (height/width) are recognized as real geometric contributions. This restores the intuition that photons are not abstract points but stable geometric carriers. It is not a change of the math itself — the Lorentz contraction and wavelength relations are unchanged — but a reinterpretation that acknowledges photons have area as well as length.

You might say that quantum mechanics 'gave up' the height dimension to make its abstract frameworks work. VMS brings it back, not by changing the equations, but by reinterpreting them: the photon carries a display-area footprint. This note helps students see that VMS is not discarding textbook math — it is using the same math but extracting deeper geometric insight from it.

Step 2A — Waveform Emergence (Caustic Size ↔ Wavelength)

Caustics → Optionality → Standard Photon Wave (A_d-first)

Caustics create optional clean routes, but whether that optionality matters is controlled in our language by display-area. Define a geometric caustic span a_c and compare the action difference built from display area, across that span, to the single scale S_0.

$$\Delta S\_A \equiv \Delta \int A\_d \, ds$$

If $\Delta S\_A \ll S_0$ over a_c, the alternatives remain genuinely competitive; if $\Delta S\_A \gg S_0$, they de-phase and wash out locally. Linearizing the A_d-based cost about straight advance gives the paraxial transverse wave equation:

$$\partial^2 \xi / \partial s^2 = c^2 \, \nabla^2{\perp} \, \xi \quad \text{(weak-fold / small-angle limit)}$$

Its solutions are transverse oscillations with two orientations; packaged as a complex amplitude this is the standard photon wave:

$$\psi(x\perp, s, t) = A(x\perp) \cdot \exp\{i(k s - \omega t + \varphi_0)\}, \quad \text{with} \quad \omega = c k$$

Only after this A_d-first step do we introduce wavelength by mapping phase to action, which yields the familiar labels and criteria:

$$\varphi = S / S_0$$

$$k = 2\pi/\lambda, \quad \omega = 2\pi c / \lambda$$

Fresnel number: $\mathcal{N}\_F = a\_c^2 / (\lambda L)$

Step 2B — Open paths → Photon sector (why light is transverse and at c)

Linearize around a straight route in a world where caustics exist. Near folds, neighboring candidate routes appear. The surface solution oscillates sideways while advancing at c. That is the photon sector: a transverse wave with two stable orientations. No EM axioms imported; geometry creates the behavior when the surface folds.

• Deliverable from this step: a wave that carries phase across routes and respects orientation, exactly what we use later.

Step 3 — Closed loops → Mass as missing space

Close the route into a loop that circulates at c. Over one cycle, it hides a fixed amount of display area. That total is the inertial measure — what I call mass. Do not picture a pebble in a field. Picture a durable circulation that keeps a chunk of space hidden. That hidden chunk is missing space.

• Local profile: closer to the loop's center, more display area is already hidden per A_d. The profile falls off with distance ($1/r^2$ behavior shows up in the smooth limit).

• What matters operationally: the profile is stationary; it biases how other routes step through the region.

Display-Area Deflation and Energy Transfer

A stable closed loop (such as an electron) can be understood as a perpetual caustic. Its closure is made possible by the requirement of display-area expansion at the point of splitting. That expansion is the positive condition that allows a harmonic loop to form and remain stable.

The reverse principle, however, is just as important: display-area deflation is what makes it possible for a stable loop to accept additional contributions of energy or momentum. You might have remembered from that same class above, two objects from one gives a larger shadow that than the original. Two added the opposite.

From the outside, this appears as photon absorption or gravitational acceleration. A photon impacting an electron would appear to destabilize the loop by adding circumference in one direction. Left unchecked, that would break closure. But the mathematics of deflation ensure that elongation in one segment is balanced by contraction elsewhere. The correction propagates around the circumference at the speed of light, so that by the time it reaches the 'head' of the loop, closure is preserved in perfect harmony with the 'tail.'

Thus, deflation is the precise mechanism by which external energy becomes internal momentum without destroying stability. To an observer, this is indistinguishable from the usual laws of dynamics: a photon adds momentum to an electron, or gravity accelerates a particle in free fall. In VMS, both are simply manifestations of the same law:

Stable closed loops can only accept new energy through deflationary adjustments that preserve harmonic closure.

Key Formulas

$$F_{split} = \Sigma_i (V_i / V)^{(2/3)} \geq 1$$

$$F_{merge} = \Sigma_i (V_i / V)^{(2/3)} \leq 1$$

$$\Delta A_{disp} = A'_{disp} - A_{disp}$$

Momentum transfer: $p' = p + \hbar k$ (photon absorption)

Gravitational acceleration: $\Delta p/\Delta t \propto G \cdot m_1 \cdot m_2 / r^2$

Step 4 — Gravity is a spinning Void's response to missing space

Bring in **another** spinning Void — the guiding loop for light or matter. It obeys two rules: (1) no sideways pile-up across boundaries; (2) no tearing of closure. When it moves through the missing-space profile around the stationary loop, the cleanest stepping changes: it leans slightly toward the region with more space already hidden and pays a tiny time premium to get past.

• Bending: the lean is cumulative; the route tips toward the mass.

• Delay: the pass near mass costs a little more route time (Shapiro-style delay at smooth-limit).

• Clock shift: park one loop deeper in the profile than another and their ticks diverge (gravitational redshift/time dilation at smooth-limit).

This is gravity in this foundation: route choice in a shaped background set by another loop's missing-space circulation. No pushes or pulls — cleaner route wins under the same rules we started with.

Step 5 — Orientation → Electromagnetism (polarity from handedness)

A closed loop carries an orientation that expansion preserves. All caustics share a common "lean" because of cosmic expansion. Relative orientation sets the sign of far-field interaction. Transport the same hidden-area content as a 2-form and you land on the source-free Maxwell equations. In this bridge, electrodynamics is the orientation half of the same geometric picture that gave us mass and gravity.

• Orientation to a common plane from expansion explains polarity and preserves compatibility with standard vacuum equations without importing them as axioms. That spin your teacher told you is not really a spin, is really a spin!

Step 6 — What We Hold Fixed (So Nothing Can Drift or Be Retrofitted)

1. Gravity doesn't care about wavelength
No wavelength-dependent coupling unless we later declare an extension. If someone claims otherwise, it becomes a test or a bound — not a contradiction.

2. No birefringence near mass in the bridge limit.
Passing light does not rotate polarization or split modes. Any observation that suggests otherwise is either a lead or a ceiling we can quantify.

3. Symmetric Systems Stay Symmetric
Ring-laser and fiber-gyro setups must stay symmetric: no mass-induced bias beyond the usual Sagnac effect. If something shows up, we treat it as a measurable deviation, not something to wave away.

4. One projection rule for geometry.
The display-area quantity is always taken as
$A_d = \pi r^2$ — not $4\pi r^2$. That prevents double-counting and keeps every comparison on the same footing.

5. The scale is locked once.
There is a single global scale:
$S_0 = \hbar$
Constants like *c* and *G* are accepted, not tuned. No parameter-by-parameter patching, and no local adjustments to make things fit.

Step 7 — One scale, three anchors (how numbers land without retune)

I set a single dimensional scale once and do not touch it again.

• Electron loop anchor → sanity checks (e/m, μ_B) emerge from the same action choice, not a fit step.

• Hydrogen lines → the same scale reproduces Balmer at spectroscopic accuracy, no new scale introduced.

• Muon lifetime → the same scale with a dimensionless escape map lands in tolerance without a second dial.

These three checks close the action–wavelength–time triangle. If any required a retune, the bridge would be broken.

Step 8 — Classical bridge (how the familiar numbers appear)

Average the rotating structure to a smooth background and keep only the leading terms. In that limit the three route effects above land on the familiar weak-field numbers for deflection, Shapiro-style delay, and gravitational redshift/time dilation. We keep this as a box you can point to — it's a reference, not a crutch — and we do not import field equations as axioms to get there.

• Nulls: no polarization rotation and no chromatic gravity in this limit; failures are bounds.

• Match: coefficients are set once to the standard weak-field limit used in GR; the same settings apply across cases.

Step 9 — Where this narrative sits and what follows

- This narrative tracks the Bridge and fixes vocabulary and commitments in plain language.
- The Walk-Through gives the derivations compactly, step by step, using the same terms.
- The Math Appendix hosts the readable equations and validity limits for cross-checks.
- Calibration & Verification provide procedures & pass/fail tables (ratio-first where tighter).

Bottom line

Mass is missing space; gravity is how another spinning Void responds to that missing space; electromagnetism is orientation on the same stage; caustics create optional routes set by display-area. One ontology, one scale, four outcomes — and the familiar numbers fall out in the smooth limit without importing someone else's axioms.