When the Limit Forgot the Nerve

A Reproduction of a June–July 2026 Wilson-Tube Limit Experiment

Reproduction note, August 2026

Provenance status. This document is a reconstructed reproduction, not the recovered original note. The original June–July 2026 calculation has not been located. The experiment is rerun from the surviving positive-thickness Wilson-tube, vacuum-descent, persistent-branch, and later nerve-compatible architecture. Exact historical notation and the exact original hypothesis list remain open.

Abstract

This note reproduces a remembered June–July 2026 experiment concerning the thick-to-thin passage of Yang–Mills Wilson-tube realizations. The remembered result was that, when the zero-thickness passage was performed without explicitly carrying the physical descent data through the selected Čech nerve, an apparent two-dimensional "worldsheet" could emerge in the limiting calculation.

The reproduction clarifies the mechanism. Objectwise thinning alone does not force such a sheet, and twisting alone does not produce an obstruction carrier. The phenomenon requires a persistent nontrivial meridional or vacuum-sector detector, a source-free vacuum condition, a physical restart admitting a simultaneous lifting problem, and a failure of that lifting problem across the thick-to-thin interface. Smooth fixed-thickness transverse representatives may then concentrate weakly onto a codimension-two set. In $3 + 1$ dimensions that set is two-dimensional. The source-free vacuum condition forbids interpreting the resulting distribution as a primitive physical worldsheet current. Reinstating the full Čech/refinement system reclassifies the sheet as the geometric shadow of a vacuum-descent interface failure rather than a newly created source.

1 Historical question and experimental aim

The remembered experiment can be stated without assuming its answer:

> Start from the positive-thickness Yang–Mills Wilson-tube realization. Restart the physical spacetime theory, retain the persistent branch data and vacuum descent, and then attempt a thin limit without first requiring the limiting operation to preserve the complete Čech/refinement coherence. Does the mathematics itself expose why the limit must be run through the nerve?

The remembered answer was that an apparent "emergent worldsheet" appeared. The purpose of the present note is to determine whether that behavior can be reproduced from the surviving construction without inserting a worldsheet at the beginning.

The required firewall is

$$\text{uncontrolled-limit worldsheet} \neq \text{prescribed incision worldsheet} \neq \text{effective confining worldsheet}.$$

Nothing in the present experiment identifies the diagnostic sheet with a physical string.

2 Do not begin with a surface

The logical order matters. The reproduction begins on ordinary, unincised spacetime. No surface, collar, boundary source, or prescribed incision is assumed.

At each positive thickness $r > 0$, one first asks whether the selected time-zero branch admits a compatible regional and spacetime realization. The obstruction is defined only as the failure of simultaneous local lifting. Its geometry is determined later.

Let

$$M_{\mathrm{reg}} := \{x \in M : \text{some neighborhood of } x \text{ supports one compatible} \\ \text{persistent physical lift of the selected branch}\}.$$

and define

$$\Sigma_{\mathrm{obs}} := M \setminus M_{\mathrm{reg}}.$$

At this stage one may infer, under restriction stability, that M_{reg} is open and Σ_{obs} is closed. One may *not* yet infer that Σ_{obs} is smooth, stratified, nonempty, or codimension two.

The interface is defined before its geometry: Σ_{obs} is the failure locus of simultaneous persistent vacuum lifting.

3 Positive-thickness Wilson and vacuum data

For a selected chart U_α and positive thickness r, write the local physical packet schematically as

$$\mathfrak{P}_{\alpha,r} = (\mathcal{A}^W_{\alpha,r}, H_{\alpha,r}, \pi_{\alpha,r}, P_{\Omega,\alpha,r}, \ldots).$$

The observable algebra and the represented vacuum data must be distinguished. Gauge-invariant Wilson observables may admit ordinary regional localization while the represented complete-ground data retain nontrivial descent.

On an overlap $U_{\alpha\beta}$, an admissible represented comparison has the form

$$U_{\alpha\beta,r} : H_{\beta,r} \widehat{\otimes} L_{\alpha\beta,r} \longrightarrow H_{\alpha,r},$$

with

$$U_{\alpha\beta,r}(P_{\Omega,\beta,r} \otimes I)U^*_{\alpha\beta,r} = P_{\Omega,\alpha,r}.$$

On triple overlaps, direct and composite routes need not agree strictly. After the selected central reduction they may differ by

$$\vartheta_{\alpha\beta\gamma,r} \in U(1),$$

so that

$$C_{\alpha\beta\gamma,r} = \vartheta_{\alpha\beta\gamma,r} D_{\alpha\beta\gamma,r}.$$

On quadruple overlaps,

$$\vartheta_{\alpha\beta\gamma,r}\vartheta_{\alpha\gamma\delta,r} = \vartheta_{\beta\gamma\delta,r}\vartheta_{\alpha\beta\delta,r}.$$

Thus higher vacuum descent is already present at positive thickness.

4 Experimental hypotheses

The reproduction uses the following package.

H1. Positive-thickness physical realization. For every selected $r > 0$, the thick Wilson packet exists locally and is physically represented.

H2. Finite-thickness descent. For each fixed r, the local packets carry admissible overlap, higher-overlap, regional, chart, Cauchy, and scale comparison data.

H3. Persistent branch datum. A selected nontrivial branch marking or detector is preserved under all admitted transports. In the explicit twisted witness one may write

$$I_3(\Omega_m) = \omega^m \neq 1.$$

H4. Vacuum source-freeness. No primitive external collar, boundary, or worldsheet source is allowed in the selected vacuum branch.

H5. Physical restart. The time-zero branch admits the selected positive-thickness spacetime/Cauchy realization needed to formulate a simultaneous lifting problem.

H6. Candidate objectwise thin convergence. The local physical objects admit candidate limits as $r \downarrow 0$.

H7. Finite-demand effectivity. Whenever all required finite descent data are retained, compatible local data reconstruct the corresponding finite regional object.

Crucially, the following is *not* assumed:

nerve-compatible thin convergence.

That is the structural requirement the experiment is designed to rediscover.

5 Run A: objectwise thinning

Take only the vertexwise limits

$$\mathfrak{P}^{\mathrm{obj}}_{\alpha,0} := \lim_{r\downarrow 0} \mathfrak{P}_{\alpha,r}.$$

Suppose every such limit exists.

This says nothing by itself about convergence of

$$L_{\alpha\beta,r}, \qquad \vartheta_{\alpha\beta\gamma,r}, \qquad \lambda_{\alpha\beta;a}, \qquad \phi_{\alpha;b,a},$$

or of the mixed regional–scale–Cauchy cells.

At positive thickness, the relevant coherence ledger contains not only vertices and edges but fixed-thickness Čech tetrahedra, regional associativity faces, chart–scale prisms, Beck–Chevalley cubes, and regional–scale–Cauchy cubes. Therefore

$$\boxed{\text{convergence of all local objects} \not\Rightarrow \text{convergence of the physical descent object.}}$$

The candidate thin realization has crossed a representation interface while discarding part of the information that licensed the positive-thickness gluing.

6 Transverse concentration as the failure mode

Near a point of failed simultaneous lifting, introduce two local transverse coordinates

$$u = (x, y).$$

Choose

$$a_r \downarrow 0, \qquad \eta \in C_c^\infty(\mathbb{R}^2), \qquad \int_{\mathbb{R}^2} \eta(u)\, \mathrm{d}^2 u = 1,$$

and define

$$j_r^{(m)}(u) = c_m a_r^{-2} \eta(u/a_r), \qquad c_m := \omega^m - 1.$$

Every $j_r^{(m)}$ is smooth for $r > 0$, but

$$j_r^{(m)} \rightharpoonup c_m \delta_0$$

weakly as $r \downarrow 0$.

Hence fixed-stage smoothness does not prevent a finite transverse defect from concentrating onto a set of vanishing transverse measure.

If the remaining coordinates are (t, z), the limiting support is locally

$$\Sigma_{\mathrm{loc}} \sim \{(t, 0, 0, z)\}.$$

This is two-dimensional.

The objectwise calculation has therefore produced a *worldsheet-shaped distributional remainder*. The word "worldsheet" here describes the support geometry of the remainder; it does not yet describe a physical source.

7 Why the vacuum condition changes the interpretation

The selected vacuum branch is source free. Its Gauss–Ward system does not admit a primitive external worldsheet current simply to absorb a failed limiting comparison. Moreover, the zero-source condition is required to persist under regional, scale, Cauchy, and mixed transport.

Consequently, when the objectwise limit produces a term schematically of the form

$$c_m \delta_\Sigma,$$

one cannot conclude

"a new physical worldsheet source has appeared."

Instead, under the vacuum hypothesis, the correct diagnosis is

$$\boxed{\text{the limiting procedure has failed to preserve the vacuum interface.}}$$

This is the central feature of the reproduced experiment. The sheet is what unresolved vacuum-descent information can look like after the descent structure has been collapsed.

8 Persistence prevents source-free point relaxation

Assume for contradiction that the candidate source-free thin vacuum realization extends through a point

$$p \in \Sigma_{\mathrm{obs}}.$$

Take shrinking transverse disks

$$D_n \downarrow \{p\}.$$

A genuine local realization restricts to every finite cover of every D_n. Once the restrictions, finite intersections, and refinement comparisons are retained, one obtains a nested marked Čech/refinement family automatically. Thus the existence assumption itself regenerates the missing descent diagram.

Under the source-free transverse tightness hypothesis, the compressed meridional defect must satisfy

$$\Delta_n^{\mathrm{mer}} \longrightarrow 0.$$

The terminal point cell has no meridional cycle and therefore carries the trivial point channel.

But persistence gives

$$I_3(\Omega_m) = \omega^m \neq 1$$

through every admitted restriction and refinement. A marking-preserving point relaxation would require

$$\omega^m \longmapsto 1,$$

which contradicts the persistent detector.

Proposition 1 (Source-free nonrelaxation at the interface)**.** *Under the persistent nontrivial detector and source-free transverse-control hypotheses, a local physical lift through a point of the obstruction carrier cannot produce an admissible point relaxation to the trivial channel.*

The obstruction therefore survives as a failure of simultaneous physical realization even though its naive distributional representative must not be interpreted as an independent source.

9 When the carrier is actually codimension two

Closedness and minimality do not determine codimension. A separate regular-support hypothesis is required.

Suppose locally there is a faithful smooth detector

$$\delta : U \longrightarrow \mathbb{R}^2$$

with

$$\Sigma_{\mathrm{obs}} \cap U = \delta^{-1}(0),$$

and suppose $d\delta$ is surjective on the zero set. Then 0 is a regular value and

$$\operatorname{codim} \Sigma_{\mathrm{obs}} = 2.$$

In $3+1$ dimensions,

$$\dim \Sigma_{\mathrm{obs}} = 4 - 2 = 2.$$

For the explicit model detector

$$\delta(t, x, y, z) = (x, y),$$

one obtains

$$\Sigma = \{(t, 0, 0, z)\}.$$

Only at this stage is the term "worldsheet" geometrically justified.

> Vacuum-interface failure + faithful two-transverse-direction detector $\Longrightarrow$ a codimension-two, hence two-dimensional, regular obstruction stratum in $3 + 1$ dimensions.

10 Run B: retain the Čech nerve

Repeat the experiment, but now carry the full selected physical descent object:

$$\mathfrak{D}_r = \big(\mathfrak{P}_{\bullet,r}, U_{\bullet,r}, \vartheta_{\bullet,r}, \lambda_{\bullet,r}, \phi_{\bullet,r}, \text{mixed cells}\big).$$

One may regard this schematically as a diagram

$$\mathfrak{D}_r : \check{C}_\bullet(\mathcal{U}_r) \longrightarrow \mathrm{Phys}.$$

The candidate thin realization is then sought as a limit of diagrams,

$$\mathfrak{D}_0 = \lim_{r \downarrow 0} \mathfrak{D}_r,$$

not merely as a family of vertex limits.

The decisive requirement is that the identification survive on every selected simplex and commute with the face, degeneracy, and higher-coherence maps.

In this run an interface failure cannot silently reappear as a primitive sheet current. Either the physical descent data extend coherently through the region, or they do not. If they do not, the failure remains explicitly represented by Σ_{obs}.

11 Why the nerve is load-bearing

The Čech nerve is not merely a convenient list of overlapping patches. It distinguishes

a globally realizable physical vacuum

from

a collection of locally convergent vacuum presentations.

Pairwise overlap convergence does not determine the triple-overlap factor

$$\vartheta_{\alpha\beta\gamma,r},$$

and scale transport itself couples the chart and scale directions through higher coherence. A valid thin realization must therefore preserve data equivalent to the complete selected descent system.

The experiment thus rediscovers the structural requirement:

$$\boxed{\text{the thick-to-thin passage must be nervewise, not merely objectwise.}}$$

12 Reproduced proposition

Proposition 2 (Vacuum-interface worldsheet diagnostic)**.** *Consider a positive-thickness Yang–Mills Wilson-tube branch satisfying H1–H7. Assume that the selected vacuum branch is source free and that a nontrivial meridional or branch detector persists under all admitted transports.*

If one forms only an objectwise thin family and does not require the full descent/refinement system to converge with that family, then objectwise convergence does not imply existence of a global thin physical vacuum realization.

If the omitted interface data admit transverse concentration, the unresolved limiting residual may be represented distributionally on the simultaneous-lifting obstruction carrier. If that carrier additionally admits a faithful regular detector with two transverse directions, then in $3+1$ dimensions its regular stratum is codimension two and hence two-dimensional.

The resulting apparent worldsheet is not, by this argument, a primitive Yang–Mills source. It is a diagnostic representation of failure to transport the physical vacuum-descent structure through the thin limit.

13 Two-run comparison

Run A: objectwise thinning	**Run B: nervewise thinning**
Thick local objects	Thick physical descent diagram
Local thin limits	Full simplexwise limiting system
Vacuum coherence partly discarded	Vacuum coherence retained
Transverse residual may concentrate	Coherence tested before globalization
Apparent worldsheet-shaped defect	Either physical lift or explicit obstruction carrier

The difference is not whether the local Wilson observables converge. The difference is whether the *vacuum interface survives the passage as structured descent data.*

14 Why this later matters for confinement

This reproduction supplies a useful negative control for later confinement questions.

A two-dimensional distributional carrier can appear without establishing confinement. Therefore

$$\text{surface appearance} \neq \text{vacuum obstruction carrier} \neq \text{dynamical worldsheet} \neq \text{confining string.}$$

The experiment answers a finer question: what does a *false positive* for a string-like manifestation look like? One answer is now explicit. If a sheet disappears or is reclassified when the full vacuum descent is restored, it was generated by the interface bookkeeping of an uncontrolled limit rather than by the later dynamical mechanism of confinement.

This sharpens the later program. A genuine string manifestation must survive the repaired physical construction and then acquire whatever additional dynamical structure—for example a positive surface cost—is required by the confinement theorem. None of that later structure is assumed here.

15 Nonclaims

This reproduction does **not** prove that:

- every uncontrolled Wilson-tube thin limit produces a worldsheet;
- the obstruction carrier is automatically smooth, stratified, or codimension two;
- twisting alone generates an obstruction carrier;
- the diagnostic worldsheet is a fundamental string;
- the diagnostic worldsheet equals a prescribed incision worldsheet;
- the diagnostic worldsheet is an effective confining worldsheet;
- a zero-thickness Yang–Mills net has been completed;
- confinement, scattering, spectral nonleakage, or a Yang–Mills mass gap follows from this experiment.

The codimension-two conclusion requires a separate faithful transverse detector hypothesis. The thin-limit conclusion is narrower:

objectwise convergence is insufficient at a vacuum-descent interface.

And for the selected Wilson-tube construction the reproduced structural lesson is:

The thin passage must retain the full Čech/refinement coherence if the limiting object is to remain a physical vacuum realization.

Provenance exit

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The limit did not create a string. It forgot how the vacuum was glued.