The Human as Throughflow Closure

A Derivation of the Human Being from the Vacuum.Net Base Model

J. Konstapel & Claude (Anthropic), Leiden, 12-8-2026. Eighth edition, after the seventh and final stress test of the theory phase.

Revision note (edition 8)

The seventh stress test cleared the paper for the protocol phase and required four final repairs. All four are made. (i) T1's model pair is now explicitly nested (Mk contains M1 at $B_2 = \ldots = B_k = 0$), the non-regularity of exponential model selection is acknowledged — parameters of absent modes vanish under the null, so standard asymptotic F-statistics do not apply — and the criterion is restricted to statistically appropriate, preregistered methods (bootstrap likelihood-ratio, AICc/BIC, or an explicitly chosen equivalent). (ii) The falsification logic is split in two steps: a detectable long-time second mode falsifies the one-pole *reduction*; by declared convention, failure of the reduction invalidates the human closure under Choice 1 — it does not by itself falsify the spectral-gap hypothesis. (iii) Chord-equivalence is defined formally: $N(W) = [C(W), <]\_\cong$. (iv) T3 now carries the protocol requirement that ν/r is an instantaneous state function, constant only while N remains within the same identity class — class constancy is a monitored condition of the experiment. With this edition the theory phase is closed; the next document is the preregistrable protocol for T1–T5.

The paper is self-contained. Every step and every equation is in the text.

Provenance

The base model in Section 1 is Konstapel's Vacuum.Net theory, condensed to its minimum. The projection onto the human being was constructed independently by the AI co-author from that base model alone. The elements that are choices, not derivations, are marked where they occur and listed in the status ledger. The paper exists so that these choices can be tested and, where they fail, replaced.

1. The Base Model

The vacuum is not empty. It is one strand, woven into a net. Eight definitions and one postulate carry everything that follows.

Definition 1 (strand). There is one 1-dimensional continuum, parameterised by arc length $s \in \mathbb{R}$. Nothing else exists. Space is not an input.

Definition 2 (contact). A contact is a pair (s, s'), $s \neq s'$, that is identified — the strand touching itself. The contact set C turns the strand into a graph G: strand segments as edges, contacts as nodes.

Definition 3 (winding). A winding is a cycle in G — a closed walk alternating strand segments and contacts — that persists under the dynamics. Its characteristic number is defined on the strand's own order: the contacts of the cycle are chords on the parameterised strand, and two chords (s_1, s_1') and

(s_2, s_2') interleave iff their endpoints alternate along the strand ($s_1 < s_2 < s_1' < s_2'$). Define **n = the number of interleaving chord pairs of the cycle**. This is a chord-diagram quantity: it needs no embedding, only the arc-length order that Definition 1 supplies. **n is not an invariant of the full dynamics.** It is conserved under pattern-preserving re-lay, defined in Section 3; re-lay outside the pattern changes it. A thing is a winding whose pattern keeps coming back. Nothing more.

Definition 4 (net). The net is G itself. Meshes are the cycle space of G. Knots are windings.

Definition 5 (tension). One scalar field $\chi(s, t) \geq 0$ lives on the strand. Its total is conserved: $d/dt \int\chi\, ds = 0$.

Postulate (the only dynamics). Tension redistributes along the strand and across contacts, toward equalisation:

$$\partial\chi/\partial t = \partial/\partial s \left(\varkappa\, \partial\chi/\partial s \right) + \Sigma_{(s,s')\in C}\, \eta_{ss'} \left(\chi(s') - \chi(s) \right) \quad (1)$$

This is diffusion on a graph. $\varkappa$ (along the strand) and η (across a contact) are the only material quantities.

Definition 6 (the four states, operational). For any region W, the states are assigned on the plane $(\bar{\chi}_W, d\bar{\chi}_W/dt)$ by a preregistered protocol: fix a rate band $\varepsilon > 0$ and two level thresholds $\theta_{low} < \theta_{high}$ before measurement. Then a point is **loading** if $d\bar{\chi}/dt > \varepsilon$; **discharge** if $d\bar{\chi}/dt < -\varepsilon$; **holding** if $|d\bar{\chi}/dt| \leq \varepsilon$ and $\bar{\chi} \geq \theta_{high}$; **rest** if $|d\bar{\chi}/dt| \leq \varepsilon$ and $\bar{\chi} \leq \theta_{low}$. Every measured point receives exactly one label once $(\varepsilon, \theta_{low}, \theta_{high})$ are fixed. A single load step produces only loading → holding; the full four-state traversal is produced by a load-on/load-off protocol: step up, hold, step down. The classification is operational and predictive only through this protocol.

Definition 7 (memory). Contact formation is not uniform. The probability of a new contact at s rises with the local winding density. New cycles form on existing cycles. The old carries the new. This layers the graph without prescribing a count of layers.

Definition 8 (property = state). Every observable of a winding W has the form $O(W) = f(N_W ; \chi_{env})$. Two arguments: **the full contact pattern N_W** — of which the interleaving invariant n of Definition 3 is one derived quantity — and the surrounding tension. Nothing else may enter. Constants are state functions. All kinetic parameters introduced later (μ, λ, ν, r, the conductances η) are properties in this sense: functions of N_W and χ_{env}, never free constants.

This is the whole base model. No universal constants, no fixed layer count, no background. Everything below must come from these nine statements or be marked as a choice.

2. The Closed Winding: Mean State, Spectrum, and the One-Pole Reduction

Consider a connected subgraph $W \subset G$ containing cycles, with capacity $C_W = \int_W ds$. Define the **mean tension**

$$\bar{\chi}_W \equiv (1/C_W) \int_W \chi\, ds.$$

Integration of (1) over W. The strand-diffusion term integrates to boundary fluxes. Every interior contact appears twice with opposite sign and cancels. Only the boundary contacts b survive:

$$C_W \cdot d\bar{\chi}_W/dt = \Sigma_b\, \eta_b \left(\chi_b^{ext} - \chi(s_b, t) \right) \quad (2a)$$

with $\chi(s\_b, t)$ the tension at the boundary point itself. This is exact.

Approximation A (fast internal equalisation). If tension inside W equalises fast relative to the exchange, then $\chi(s\_b, t) = \bar{\chi}\_W(t)$ up to corrections of relative order τ_in/τ_out, and (2a) becomes

$$d\bar{\chi}\_W/dt = (1/C\_W)\ \Sigma\_b\ \eta\_b\ (\ \chi\_b\text{^}ext - \bar{\chi}\_W\ ).\ (2)$$

The spectrum. Equation (1) restricted to W with fixed environment is linear: $\dot{\chi} = -L\ \chi + b$, with L the weighted graph Laplacian of W augmented by the boundary conductances. The general response is a sum over eigenmodes with many relaxation times. One exponential is not automatic.

Choice 1 (retention, spectral form). Let $1/\tau\_exch = \Sigma\_b\ \eta\_b / C\_W$ be the rate of the global exchange mode, and λ_int the rate of the slowest purely internal mode (the spectral gap of W's interior). Define

$$\varrho \equiv \lambda\_int \cdot \tau\_exch = \tau\_out / \tau\_in.\ (3)$$

$\varrho \gg 1$ is the definition of an inside. The logic of the reduction is: large internal gap → under Approximation A the internal state collapses to one collective variable $\bar{\chi}\_W$ after a transient of duration $\sim 1/\lambda\_int$ → the resulting external model (2) is a one-pole relaxation. The claim is not that the full original network retains one eigenmode; it is that one effective state variable suffices, and its dynamics has one time constant. With several boundary contacts at different outside tensions, (2) still has a single pole, with equilibrium $\bar{\chi}\_\infty = \Sigma\_b\ \eta\_b\ \chi\_b\text{^}ext / \Sigma\_b\ \eta\_b$.

Under this reduction, a step change in the environment gives, beyond the transient,

$$\bar{\chi}\_W(t) = \bar{\chi}\_\infty + (\ \bar{\chi}\_0 - \bar{\chi}\_\infty\ )\ e\text{^}\{-t/\tau\_W\},\ \tau\_W = C\_W / \Sigma\_b\ \eta\_b.\ (4)$$

Conditional statement. Equation (4) is a property of windings satisfying the spectral condition, not of the model in general. Every closed winding satisfying it has one characteristic time: capacity over boundary conductance. Holding is a relaxation time, measurable by step response.

In the plane of Definition 6 the response (4) is a monotone approach to equilibrium. Under the spectral reduction, the four states are four experimentally distinguishable regions of the effective state trajectory, assigned by the preregistered protocol of Definition 6 — not four separate orbits of the system. A single step exhibits loading → holding; the load-off half of the protocol exhibits discharge → rest. The classification is exactly as strong as equation (4) plus the protocol.

3. The Throughflow Closure: Maintenance, Saturation, and the Window

A closed winding by itself relaxes to its surroundings and is done. The following laws change that. Each is a model choice, stated as such, with its testable content.

Choice 2 (re-lay law). Contacts decay when no tension difference stands across them; an idle contact is not re-laid. Write the decay rate λ. Contact formation follows the local gradient; the re-lay rate during load is $\mu \cdot J$, with J the current through the winding. Definition 8 permits the contact kinetics to be state functions of the tension field; it does not fix this linear form.

The identity pattern, and what re-lay conserves. Distinguish three things. **N is the identity pattern**, defined formally as

$N(W) = [\, C(W), < \,]_{\cong}$

— the chord structure $C(W)$ of the winding together with the ordering $<$ induced by the strand's arc-length parameterisation, taken up to isomorphisms that preserve the interleaving relation. "Same pattern", "pattern-preserving" and $C_{min}(N)$ all refer to this one equivalence. A **realisation** is the currently maintained contact set within that class. A re-lay event is **pattern-preserving** when the replacement contact lands in the same chord class as the decayed one: its endpoints lie in the same strand intervals, bounded by the neighbouring contacts of the pattern, so $[C, <]_{\cong}$ — and hence n — is unchanged. Under pattern-preserving re-lay, n is conserved **by construction**: maintenance replaces material, not structure. Re-lay outside the class changes N. **The drift rate νJ of Choice 2c below is exactly the rate of non-preserving re-lay events**, and repair r is their correction back into the class. Invariant and dynamics thus use one machinery: conservation is what maintenance does; drift is its measured violation; a change of N is a change of identity.

This also fixes C_{min} without circularity: **$C_{min}(N)$ is the size of the smallest sub-realisation of the class N that still closes every defining cycle of the pattern** — the minimum contact subset required to preserve the identity pattern, not the pattern itself. C_{min} is a function of N by construction.

Choice 2c (drift and repair). Re-laying follows the instantaneous gradient, so under load a fraction of re-lay events lands outside the chord class: the realisation drifts away from N at rate νJ. The drift is repaired during equalisation phases — boundary conductance down, internal equalisation only — at repair rate r. During those phases $J \approx 0$: rest suspends both intake and re-lay.

The duty cycle, done correctly. Let f be the fraction of time spent in equalisation phases. Stationarity of the pattern deviation requires average drift to equal average repair:

$$(1 - f) \cdot \nu J = f \cdot r \Longrightarrow f = \nu J / (\nu J + r). \quad (7)$$

The rest fraction is linear in load only for $\nu J \ll r$, and saturates toward 1. It never reaches 1: drift does not impose a hard upper edge. What it imposes is saturation.

Maintenance under the duty cycle. Re-lay runs only during load; decay runs always. The stationary pattern is

$$C_W^*(J) = (1 - f)\, \mu J / \lambda = \mu r J / [\, \lambda (\nu J + r) \,] \quad (5')$$

which rises with J and saturates:

$$C_W^*(J) \rightarrow \mu r / (\lambda \nu) \text{ as } J \rightarrow \infty.$$

A winding that sits on a gradient maintains its own contact pattern — up to a ceiling set by its own repair capacity. This is the definition of life in this model: not a substance, but a closure in throughflow that re-lays itself. Holding oneself together costs current ($J \rightarrow 0 \Longrightarrow C_W \rightarrow 0$); the closure is self-repairing (small damage returns to C_W^*); and its maintenance saturates.

Choice 2b (gradient depletion — the environmental bound). The sustaining gradient is itself finite. Model the surrounding mesh as a reservoir of capacity C_{env}, recharged at rate R and drained by the throughflow:

$$C_{env} \cdot d(\Delta\chi)/dt = R - J, \; J = \eta_W \Delta\chi. \quad (6)$$

R is not creation of tension; it is inflow from the remainder of the globally conserved net. Definition 5 holds globally; the reservoir is locally open, globally closed.

Steady state: $J^* = R$, $\Delta\chi^* = R/\eta_W$. **Sustainable** throughflow saturates at the recharge rate of the environment, independent of the winding's own conductance; transiently $J > R$ is possible while the reservoir depletes. **This bound is a property of the chosen environment model, not of the closure itself, and it bounds the steady state, not the instant.**

The window, rebuilt from (5′)–(7). Closure requires $C_W^* \geq C_{min}(N)$, with $C_{min}(N)$ as defined above. Three conditions follow.

1. **Constitution:** $\mu r > \lambda \nu C_{min}(N)$. The saturation ceiling must clear the threshold at all. Whether this winding can live is a property of (μ, λ, ν, r, C_{min}) — all functions of N_W by Definition 8, now validly so — before any environment is specified.

2. **Lower edge:** solving $C_W^*(J) = C_{min}$ gives, in closed form,
   $J_{min} = \lambda C_{min} r / (\mu r - \lambda \nu C_{min})$.
   Below it, the pattern decays through the threshold.

3. **Upper edge (environmental, steady-state):** sustained $J \leq R$ from (6). The environment cannot supply more indefinitely; transient exceedance runs on the depleting reservoir.

Note also, confirmed in the third test: $dC_W^*/dJ = \mu r^2 / [\lambda(\nu J + r)^2] > 0$ with limit $\mu r/(\lambda\nu)$ — the closure is monotone in load and has its own asymptotic maintenance ceiling.

Life exists in a **sustainable steady-state window** $J \in [J_{min}, R]$, with a constitutional existence condition in front of it, and with effective performance saturating at r/ν well before any edge is reached. Each statement is traced to a named equation, and the upper edge to the chosen environment model.

4. The Tower and the Human

Choice 3 (the closure operator). Define, for any set of windings $\{W_i\}$ of any level:

$K(\{W_i\})$ = a subgraph S connecting the W_i, with cycles running over the W_i as wholes, and $\varrho_S \gg 1$ in the spectral sense of (3).

K makes one winding out of several. Definition 7 guarantees that K can be applied again. Define the tower

W^0 = the smallest stable cycle, $W^{(k+1)} = K(\{W^{(k)}\})$.

The number of levels is not postulated.

Lemma (what K does to τ, derivable). Capacity is additive: $C_S = \Sigma_i C_i$. Closure internalises contacts: the strand segments carrying the new cycles between W_i and W_j cease to be boundary. Hence

$\Sigma_b \eta_b^S = \Sigma_i \Sigma_b \eta_{b,i} - \eta_{int}$, with the side condition $0 < \eta_{int} < \Sigma_i C_i/\tau_i$

(the remaining boundary conductance must stay positive — physically evident, now explicit),

and therefore

$\tau_S = \Sigma_i C_i / (\Sigma_i C_i/\tau_i - \eta_{int}) > \Sigma_i C_i / (\Sigma_i C_i/\tau_i)$.

The right-hand side is the **capacity-weighted harmonic mean** of the constituent times. So the lemma states, precisely: τ_S lies above the capacity-weighted harmonic mean of the underlying times, and grows with the internalised fraction. This much follows from the construction. It does **not** by itself give $\tau_S > \max_i \tau_i$.

Choice 3b (scale separation). K is admissible only when internalisation is strong enough that

$\tau_S \geq \sigma \cdot \max_i \tau_i, \sigma > 1$.

The strict ordering of time scales through the tower is this chosen admissibility condition, not a consequence of Choice 3. T4 tests precisely 3b.

Definition (human). A human is a throughflow closure of depth m in the tower: the spectral condition, the window conditions, and 3b hold at level m, over constituents for which they hold at level m − 1. In short: human = closure + spectral condition + window + 3b. The consequence is stated plainly: the human scale is not derived from Vacuum.Net alone — an explicitly chosen temporal selection criterion (3b) is part of the definition, and T4 is its test.

Current science names the lower levels cells and molecules and describes them biochemically. This construction does not need those names. Every statement about the human is made at level m, in four quantities:

- **N** — the contact pattern. Discrete. Fixed while the closure holds. The blueprint.
- $\bar{\chi}$ — the mean tension. Continuous. How the person is doing.
- $\boldsymbol{\tau}$ — the retention time. Capacity over boundary conductance. How long the person holds.
- **J** — the throughflow. What the holding costs.

5. The Derived Properties

Each of the following is read off the construction. None requires an assumption beyond the labelled choices.

Identity. The strand segments and contacts in W are continually replaced: (5′) re-lays realisations, it does not preserve them. What persists is N — the chord-equivalence class, not the material and not any particular contact set. In the cell picture, total molecular turnover with persistent identity is a paradox. Here it is Definition 3: the thing *is* the pattern that keeps being re-laid into the same class.

Origin. A new closure is laid on existing strand (Definition 7) — on the strand of two existing closures. N_{new} inherits substructure from both carriers, plus the tension state of the moment of knotting. Heredity and moment of origin are two components of one invariant.

Growth. K is repeated internally under 3b: τ rises by at least σ per level. Growth is not addition of material but deepening of closure.

Perception. Boundary conductances are state functions: $\eta_b = \eta(\chi_b)$. An outside pattern $\chi_b(t)$ modulates the inflow, and through the one-pole reduction that pattern stands as a state change *inside* W after time $\sim 1/\lambda_{int}$. Perception is outside tension walking in along one's own contacts. No representation step. The correlation is the contact.

Action. The same equation, other direction: W sets a disturbance $\delta\chi$ into the surrounding mesh through its boundary. Whether δ persists depends on its phase overlap with the mesh state. Selection by fitting. No causal arrow.

Simultaneous cycles. The four-state orbit runs at every level of the tower, each with its own τ, separated by at least σ under 3b. One human carries several loading–discharge cycles at once, at separated tempi.

Rest. Choice 2c, read forward: the duty cycle (7) makes rest periodically necessary, with fraction $f = \nu J/(\nu J + r)$ — small under light load, approaching but never reaching 1 under heavy load.

Death. The spectral or window condition fails. J collapses, C_W decays to 0, χ redistributes along the remaining contacts of the mesh. N does not vanish — a pattern once laid is strand history (Definition 7). It only ceases to re-lay itself.

6. What the Model Makes Obligatory

T1. One-pole response as a model-selection experiment — the test of Choice 1. Apply a defined load step; record $\bar{\chi}(t)$ with known noise level σ_{noise}. Fit the preregistered **nested** models

M1: $\bar{\chi}(t) = A + B_1 e^{-t/\tau_1}$ Mk: $\bar{\chi}(t) = A + \Sigma_{i=1..k} B_i e^{-t/\tau_i}$, $k \geq 2$, containing M1 as the submodel $B_2 = \ldots = B_k = 0$.

Exponential mixture selection is a **non-regular** problem: under M1 the parameters (B_i, τ_i) of the absent modes vanish from the model, so standard asymptotic F-statistics do not hold. The selection criterion must therefore be a preregistered, statistically appropriate method — bootstrap likelihood-ratio, AICc/BIC with a declared threshold, or an explicitly chosen equivalent — together with, fixed before measurement: the minimal detectable second mode (amplitude ratio $B_2/B_1 \geq \beta_{min}$ given σ_{noise}, and time-scale separation τ_2/τ_1 outside a declared indistinguishability band) and the transient window $\sim 1/\lambda_{int}$ excluded from the fit.

The falsification logic runs in two declared steps. Step one: a detectable long-time second mode above the preregistered floor, reproducible across repetitions, falsifies the **one-pole reduction** for this winding. Step two, by convention fixed in this paper: failure of the one-pole reduction invalidates the human closure **under Choice 1** — the individual, as defined here, does not exist as a single-state object. It does **not** by itself falsify the spectral-gap hypothesis: a fast internal mode outside the fit window, or a weak external mode from boundary structure, can produce a second mode while ϱ remains large. Attribution to the spectral gap requires the separate check that the detected mode is internal and slow. The strongest and most exposed prediction — now decidable identically by independent researchers, with its target named at each step.

T2. A window with three traceable conditions. A constitutional condition ($\mu r > \lambda\nu C_{min}(N)$), a lower edge ($J_{min}$ in closed form), and a sustainable steady-state upper edge (R, from the chosen reservoir model; transient exceedance allowed). The first two are functions of N_W — per person, calibratable, stable while N holds — with $C_{min}(N)$ defined in Section 3. T2 tests Choices 2/2b/2c in combination — and a measured sustainable upper edge that does *not* track the environment attacks 2b specifically.

T3. Rest fraction: linear onset, saturation. From (7): $f = \nu J/(\nu J + r)$. Linear in load only at low load, with per-person slope ν/r; saturating shape at high load. The *shape* is the test: measured linearity persisting at high load, or saturation at a level other than 1, attacks Choice 2c. **Protocol requirement:** ν and r are instantaneous state functions $\nu(N, \chi_{env})$, $r(N, \chi_{env})$; the prediction assumes ν/r constant over the measurement, which holds only while N remains within the same identity class. Class constancy is therefore a monitored condition of the experiment, and a drifting ν/r with evidence of class change is a boundary-condition failure, not a falsification of 2c.

T4. Separated simultaneous time scales — the test of Choice 3b. Loading–discharge cycles at distinct tempi must coexist in one individual, orderable by tower level, with ratio $\geq \sigma$ between adjacent levels. Overlapping tempi at adjacent levels falsify 3b, not the tower's existence.

T5. The tower continues above the human. K applied to humans yields closures with retention above the closure bound but below the human's: $\mathbf{1 \ll \varrho\_group < \varrho\_human}$ — pair, family, group are genuine closures, more weakly held than their members. Same mathematics — equation (2) with humans as nodes. Measurable: shared $\bar{\chi}$ dynamics of a pair under a step load on one member, showing a joint slow mode absent for two uncoupled individuals.

The failure map: T1 → Choice 1. T2 → Choices 2/2b/2c (upper edge → 2b). T3 → Choice 2c. T4 → Choice 3b. T5 → Choice 3. The choices are exactly the places where the projection can die.

7. Correspondence with Existing Physics

Every building block exists in the standing literature, spread over separate fields. The claim is not new physics but one claim of unity: these are not nine descriptions of nine systems, because there is one strand.

Windings as things: vortex atoms and topological solitons. Equation (1): the graph Laplacian, Kirchhoff networks, standard transport theory. The spectral condition and one-pole reduction: time-scale separation, quasi-equilibrium, model reduction to a slow manifold. The throughflow closure: dissipative structures — order that exists only while current runs through it. The duty cycle (7): standard renewal/duty-cycle balance. Equation (6): finite-reservoir source dynamics. The four states: relaxation oscillators, stick–slip, integrate-and-fire. Property as state: effective constants in condensed matter; running couplings. The tower with internalisation: renormalisation-group layering; coarse-graining that converts interface to interior. Coupled closures: synchronisation theory.

The single point of departure from the standing frame: there, constants are universal and the vacuum is a fixed background. Here, constants are state functions and the background is the system.

8. Status Ledger

Base (Konstapel). Definitions 1–8 and the postulate.

Derived. (2a), exact. (2) under Approximation A. The duty-cycle balance (7) and the saturating maintenance law (5′) given Choices 2/2c, including monotonicity and ceiling. The window's constitutional condition and lower edge, in closed form. The rest fraction. The tower lemma (τ_S above the capacity-weighted harmonic mean of the constituent times, growing with internalisation). Section 5.

Conditionally derived. (4): a property of windings satisfying the spectral condition; whether humans are such windings is T1. Conservation of n: holds under pattern-preserving re-lay by construction; ν J is the rate of its violation — n is a conditional invariant, not an invariant of the full dynamics.

Chosen — the places to attack. Choice 1: the spectral gap as the definition of an inside. Choice 2: the linear re-lay law. Choice 2b: the reservoir equation (6) — source of the environmental upper edge. Choice 2c: the linear drift law. Choice 3: the operator K. Choice 3b: scale separation $\sigma > 1$ as admissibility of K.

Obligatory and testable. T1–T5, with the failure map.

Open. The count of tower levels. The form of N for an actual human. Re-lay and drift laws beyond linear. Whether 3b can be derived from a physical selection principle instead of chosen. The coupling algebra for two humans becoming one mesh. And the agreed next front: an operationalisation of T1–T5 precise enough that two independent researchers with the same data reach the same falsification criteria.

Annotated References

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