

Eleven Questions, Three Gaps

The 2026 Leiden Vidi Projects Read through the Vacuum.Net Theory

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Abstract

On 22 October 2026, eleven researchers of Leiden University received a Vidi grant from the Dutch Research Council. Their projects run from quantum materials to Swahili poetry. Each project is built around a question that the field cannot yet answer.

This essay takes the eleven one by one. For each researcher it summarises the work, states the open problem, and reads that problem with the Vacuum.Net theory. The theory is explained in full in Section 2, with every count worked out in the text.

The main finding is simple. The eleven open problems are not eleven different gaps. They fall into three kinds. Some concern *form*: what closes and what stays open. Some concern *order*: how an earlier passage colours a later one. Some concern *state*: how the value of a quantity depends on its surroundings. These three are the second, third and fourth axioms of the theory. The standard method looks for a cause in a part. It therefore leaves exactly these three properties of the whole as a remainder.

For each researcher the essay names one count that can be made with published or forthcoming data.

1. Why These Eleven

A Vidi grant goes to researchers who have shown a line of their own. It is personal, it runs five years, and it supports the start of a research group. The eleven Leiden projects of 2026 are therefore not random. Each is a mature question in a strong group.

Read side by side, the project descriptions show a pattern. Eight of the eleven say, in their own words, that something is “not understood”, “not well understood” or “unclear”:

- how electrons in a quantum material become one wave;
- how bacteria recognise viral DNA by its shape;
- how cosmic radiation drives chemistry in interstellar ice;
- why inflammation in Crohn’s disease does not stop under treatment;
- why patients with the same autoimmune disease respond so differently;
- what happens in the silent years before rheumatic disease appears;

- how expectations about social change alter behaviour;
- how molecules can react with enzymes in a precise and controlled way.

The other three are reconstructive. They ask how stories travel between islands, how plague moved through Dutch towns, and how societies formed in unpredictable deserts. Their gap is mostly a gap in data.

This essay asks what the eleven questions look like when they are read with one theory that has form, order and state as its foundations.

2. The Vacuum.Net Theory

This section states the theory as far as the essay needs it. All counts are given in full. Nothing in later sections depends on a source outside this text.

2.1 The picture

The picture is a fishnet in water. One strand runs everywhere and crosses itself. The strand is under tension. Where it winds around itself, knots form. Between the strands lie meshes.

Four words carry the theory:

- **Strand** — the one line that makes up the net.
- **Winding** — a part of the strand that returns on itself in phase.
- **Knot** — a place where the strand passes more than once.
- **Mesh** — an opening between strands, with an extent in space or in time.

2.2 The register: three states

At every crossing, the strand has one of three states: +1, 0 or −1. This unit is a *trit*. The three states are not “yes, no, maybe”. They are two directions and the point where the directions meet.

2.3 The window and the rule of closure

Three crossings that follow each other along the strand form a **window**. A window **closes** when the sum of its three trits is 0, counted in threes. Counted in threes means that +3 and −3 also count as 0.

The selection rule is one sentence: **what closes, stays; what does not close, passes on as tension.**

2.4 The count: nine of twenty-seven

Three states on three places give $3 \times 3 \times 3 = 27$ windows. The closed ones are:

1. Three equal values: (+,+,+), (0,0,0), (−,−,−). Their sums are +3, 0 and −3. All count as 0. That is 3 windows.
2. Three different values: the orders of (−, 0, +). There are $3 \times 2 \times 1 = 6$ orders. Each sums to 0. That is 6 windows.

Together: $3 + 6 = 9$ closed windows. The other $27 - 9 = 18$ are open.

The open ones always have two equal values and one different value. The proof is short. Two equal values a and a third value b give $2a + b$. For this to be 0 in threes, b must equal a . Then all three are equal, which contradicts the

assumption. So a window closes **only** when its trits are all equal or all different.

This is the first fact used in this essay: **closure comes in two kinds** — sameness and full difference. Mixed windows never close.

2.5 Two rings and a seam

Take the six windows with three different values. Read them as rings: a ring has no starting point. Six orders divided by three rotations give two rings:

- the **left ring**: $-1 \rightarrow 0 \rightarrow +1$;
- the **right ring**: $+1 \rightarrow 0 \rightarrow -1$.

They hold the same three values. They differ only in direction. The 0 sits in the middle of both. It is not a rest state. It is the point where the two directions meet.

Put a left ring against a right ring: $-, 0, +, +, 0, -$. The windows along this row are:

Window	Sum	State
$(-, 0, +)$	0	closed
$(0, +, +)$	2	open
$(+, +, 0)$	2	open
$(+, 0, -)$	0	closed

Where two closed structures of opposite direction meet, two open windows appear. This place is a **seam**. A seam is always open, and its open windows come in pairs.

2.6 Half a turn

A rotation in space can be written as two reflections. The object that performs the rotation (the *rotor*) carries half the angle. After one full turn of 2π , the rotor stands at -1 . After two full turns, 4π , it stands at $+1$ again. The object looks the same after 2π . The rotor that describes it needs 4π .

So there are two kinds of return. A return after 2π is a closed winding as seen from outside. A rotor at -1 is half a closure: it looks complete but carries the opposite sign. This is the second fact used in this essay: **a half-closed state carries a minus sign**.

2.7 How closure depends on the mix of states

Suppose the three states do not occur equally often. Let one state have probability m . Let the other two each have probability $(1 - m)/2$. How likely is a window to close?

The exact answer uses the cube roots of unity. Write $\omega = e^{(2\pi i/3)}$. The probability that three independent trits sum to 0 in threes is

$$P(\text{closed}) = \frac{1}{3} \cdot [1 + \hat{p}(\omega)^3 + \hat{p}(\omega^2)^3],$$

where $\hat{p}(z) = p_0 + p_1 z + p_2 z^2$. For the mix above, $|\hat{p}(\omega)| = (3m - 1)/2$, and the formula reduces to

$$P(\text{closed}) = \frac{1}{3} + \frac{2}{3} \cdot ((3m - 1)/2)^3.$$

Worked values:



<i>m</i>	0.333	0.5	0.6	0.7	0.8	0.9
P(closed)	0.333	0.344	0.376	0.444	0.562	0.743

A direct count over all 27 windows gives the same numbers.

The excess above $\frac{1}{3}$ grows with the **third power** of the imbalance. This has a direct consequence. A slow drift towards one state stays almost invisible for a long time. From $m = 0.33$ to 0.5, the closing probability rises by only 0.011. From 0.6 to 0.8 it rises by 0.186. This is the third fact used in this essay:
closure under drift is silent first and steep later.

2.8 The five axioms

The theory has five axioms.

- **N1 — Strand.** There is exactly one strand. Every distinction is a crossing of the strand with itself.
- **N2 — Closure.** A crossing persists if and only if it lies in a closed window. What does not close passes on as tension.
- **N3 — Memory.** At every knot the passages are ordered. The first passage fixes the orientation. Later passages are counted relative to it.
- **N4 — Context.** Every constant is a function of the strand. A “fixed” value is a property of the local state.
- **N5 — Scale.** Merge places into blocks. The coarse strand obeys the same four axioms again. What does not close at one scale is the material of the next.

Two further statements follow from the definitions:

- **The observer is a knot.** It is part of the strand and meets every passage through its place.
- **Passage scales with one over the open size.** Energy per unit of time has the dimension of one over length. A narrow mesh carries more passage per unit of time than a wide one.

2.9 How the theory reads a finding

The theory does not offer a mechanism in which one part causes another. In a net of one strand there are no two separate things to put an arrow between. It offers four other forms of statement:

- **selection by fit** — only what returns in phase stays;
- **identity over scale** — the same winding at another depth;
- **constitutive relation** — two quantities that are fixed together, without an arrow;
- **correspondence** — the same count in two domains.

Every reading in this essay has one of these forms.

2.10 Status words

Each statement in this essay carries one status:

- **source** — taken from the researcher’s own publication;
 - **counted** — computed in this text and checked;
 - **reading** — a pairing of a quantity in the theory with a finding, without a test;
 - **open** — a count that can be made but has not been made.
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3. How Each Project Is Read

Each of the eleven sections has the same five parts:

1. **The work** — what the researcher has found so far.
2. **The open problem** — what the Vidi project sets out to solve.
3. **What the net shows** — the open problem read with the theory.
4. **What the field misses** — what becomes visible with the theory that is not visible without it.
5. **The count** — one count that can be made with published or forthcoming data.

The order follows the university's announcement.

4. Marta Artola Perez de Azanza — Two Directions through Three Shapes

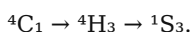
Leiden Institute of Chemistry. Vidi project: a new class of molecules that react with enzymes in a precise and controlled way. The aim is new routes to drug design, including antibiotics.

The work

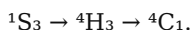
Artola designs molecules that bind and block glycosidases. These enzymes cut sugar chains. They matter in rare metabolic diseases such as Gaucher and Fabry disease, in cancer, and in bacteria.

A sugar ring is not flat. It takes defined shapes, named by codes such as ${}^4C_1$ (a chair), ${}^4H_3$ (a half-chair) and ${}^1S_3$ (a skew boat). An enzyme does not cut the sugar in one step. It moves the sugar through a fixed series of shapes. This series is the *conformational itinerary* (**source**).

For a retaining α -glucosidase the itinerary is:



For a retaining β -glucosidase it is:



The middle shape, ${}^4H_3$, is the transition state. It is the same in both. In the second half of the reaction, the enzyme runs its route back (**source**).

Artola's key step was to lock a molecule in one of these shapes. A cyclophellitol cyclosulfate held in the ${}^4C_1$ chair blocks α -glucosidases quickly and permanently. The same lock barely touches β -glucosidases (**source**). Specificity comes from which shape is locked, not from how reactive the molecule is. A carba-cyclophellitol with no reactive group at all still binds strongly, because it holds the transition shape (**source**).

The open problem

The Vidi project asks for molecules that react with enzymes "in a precise and controlled way". The field still designs mostly by trial: synthesise a library, measure, refine. A general rule for which shape will select which enzyme is not available.

What the net shows

Label the three shapes with trits. Let the starting chair be -1 , the transition half-chair 0 , the final skew boat $+1$.

- The α -route is $-1 \rightarrow 0 \rightarrow +1$. That is the **left ring**.
- The β -route is $+1 \rightarrow 0 \rightarrow -1$. That is the **right ring**.

Both are windows of three different values. Both sum to 0 . Both close. They hold the same three shapes and differ only in direction. The transition state is the 0 : the point where the two directions meet (**counted**).

A retaining enzyme runs one ring forward and then the same ring back. Forward and back together return the sugar to its starting orientation. That is why the configuration is *retained*. An inverting enzyme runs one route once, in one direction, and stops. The product comes out mirrored. That is why the configuration is *inverted* (**source** for the chemistry; **reading** for the pairing).

So the two great classes of glycosidases correspond to the two ways of using a ring of three: once, or there and back.

What the field misses

The field treats a locked shape as a key that fits a lock. The net adds a second property: **direction**. The same three shapes serve two enzyme classes. What separates them is the order in which the shapes are passed.

A molecule that is locked in the 0 -shape — the transition state — fits both directions. It will tend to be broad. A molecule locked in one end shape fits one direction only. It will tend to be selective. This fits the pattern in Artola's own work. Cyclophellitol aziridines, which hold the ${}^4H_3$ transition shape, serve as broad-spectrum probes across many retaining enzymes of a class. The ${}^4C_1$ -locked α -cyclosulfate acts on α -enzymes only (**source** for both; **reading** for the rule).

For new antibiotics this gives a design rule. Choose an enzyme whose ring runs in the direction opposite to the nearest human enzyme. Lock the molecule in the end shape that belongs to the bacterial direction only.

The count

For every glycoside hydrolase family with a known itinerary, record the start shape, the transition shape and the end shape. Check two statements. First: every retaining family runs one ring there and back. Second: every inverting family runs one route once, and its end shape is never its start shape. The data exist in the CAZy database and in the structural literature that Artola co-authored.

5. Rachel Knevel — The Silent Years

Leiden University Medical Center. Vidi project: computer models that recognise early signals of rheumatic autoimmune disease in medical records. The risk estimate is updated at every care contact.

The work

Knevel is a rheumatologist and a data scientist. Her group built machine-learning pipelines that find patients with rheumatoid arthritis in free text of electronic health records. In the Leiden records, a support vector machine

identified 2,873 patients out of 23,300 in under seven seconds, with a positive predictive value of 0.94 (**source**).

Other Dutch work on the same question used general-practice records. Future arthritis patients visited their GP more often for joint and muscle complaints than controls. The difference began 4 to 6 years before diagnosis. It became statistically significant only about 1.5 years before diagnosis. The odds ratios at 18, 12 and 6 months before diagnosis were 2.5, 2.8 and 3.2 (**source**).

The open problem

Autoimmune rheumatic disease starts years before the first clear complaint. Early symptoms are vague. Each one alone says little. The Vidi project wants a model that sees the disease coming earlier, by updating the risk at every contact.

What the net shows

Treat each care contact as a passage through a knot: the patient. By N3, the first passages fix an orientation, and later passages count relative to it. A model that updates at every contact is N3 written as a rule of computation.

Now take the shape of the signal. Suppose the balance of a person's state drifts slowly from even towards one side. Section 2.7 shows that the closing probability then rises with the third power of the imbalance.

Assume, as a simple case, that the imbalance grows linearly over the six years before diagnosis. Then the share of the final excess that is present at a given time is the cube of the elapsed fraction:

Years before diagnosis	Elapsed fraction	Share of final excess
4.5	0.25	0.016
3.0	0.50	0.125
1.5	0.75	0.422
0	1.00	1.000

So $1 - 0.422 = 0.578$ of the excess arrives in the last 1.5 years. That is 58% of the signal in 25% of the time (**counted**, under the stated assumption).

This matches the published pattern in form. The curves separate 4 to 6 years ahead. They become significant only about 1.5 years ahead (**reading**).

What the field misses

The field looks for better single signals: a lab value, a symptom, an antibody. The net says the early signal is not in any single passage. It is in the order and the run of passages. In the silent years, each passage is almost even. The excess is cubic, so it is tiny early and large late.

Two consequences follow. First, a model that weighs single contacts will always find the signal late. A model that weighs the sequence — which contact came first, which kept returning — can find it earlier. Second, the best moment for prevention lies before the steep part, where single signals are weakest. There, only the sequence carries information.

The count

Fit the published odds ratios over the full window of 6 to 72 months against powers of elapsed time. If the excess is cubic, an exponent near 3 fits best. The GP-record study reports the needed series. Knevel's own records, with dates of every contact, allow the same fit at the level of single patients.

6. Kaveh Lahabi — Windings, Seams and a Net of Junctions

Leiden Institute of Physics. Vidi project: a microscope that shows how the collective electron wave flows in quantum materials.

The work

Lahabi studies where supercurrent flows in a material. His results fall into four lines (**source** for all).

1. **Triplet currents in ferromagnets.** In disc-shaped niobium/cobalt junctions, the disc forces a magnetic vortex. The supercurrent then runs in narrow channels at the rim, less than 80 nm wide. It also runs at the rim without a vortex, but not in bars.
2. **Superconducting memory.** An elliptical junction switches with a field of 40 mT between two stable magnetic patterns: uniform, or two vortices. Each pattern gives a different critical current.
3. **Sr₂RuO₄ microrings.** Rings cut from single crystals show oscillations of resistance with magnetic flux. Above an in-plane field of about 10 mT, maxima turn into minima. The authors read this as half-quantum fluxoid states. In homogeneous rings, two Josephson junctions appear by themselves, at walls between domains of opposite chirality.
4. **Kagome superconductor CsV₃Sb₅.** Below the critical temperature a network of Josephson junctions forms by itself inside an unstructured flake. A scanning SQUID microscope shows narrow channels of supercurrent. They appear at the critical temperature and stay at all lower temperatures. The network is strong in tin-doped samples and weak in undoped ones. It accounts for several anomalies reported by others: intrinsic junctions, flux periods suggesting charge 4e and 6e, and a diode effect without a field.

His former supervisor Jan Aarts co-authored the first π -junction. In that junction the critical current falls to zero on cooling and then rises again with the opposite sign (**source**).

The open problem

In ordinary metals, electrons behave as single particles. In quantum materials they act together as one wave. The Vidi text states it directly: researchers do not understand how this wave arises. The new microscope is meant to show where and how it flows.

What the net shows

The vortex is a winding. Each vortex carries exactly one flux quantum, $\Phi_0 = h/2e = 2.068 \times 10^{-15}$ Wb. This is one closed turn of the phase, 2π (**counted** from CODATA values). A vortex is the net's winding in its most literal form.

The half quantum is the seam. A half-quantum fluxoid, $\Phi_0/2 = 1.034 \times 10^{-15}$ Wb, is a phase turn of π . By Section 2.6, it is half a closure. It looks complete from outside but carries a minus sign. In Sr₂RuO₄ these states and the

spontaneous junctions sit exactly at walls between domains of opposite chirality — between a left-handed and a right-handed region. That is the seam of Section 2.5: where two closed structures of opposite direction meet, open windows appear (**reading**).

The π -junction is the register. On cooling, the critical current goes from positive through zero to negative. The coupling passes through +1, 0 and −1. The 0 is not a plateau. It is the point where two directions cancel (**reading**).

The rim selects. In discs, the current runs at the rim. It runs there with or without a vortex. In bars it does not. The edge of the medium is where closure is possible (**reading**).

The kagome network is a mesh. Channels form by themselves at the critical temperature and do not move. The flux periods that suggest charge $4e$ and $6e$ appear when two or three junctions in a loop act together. In the net, a period of $h/6e$ is a window of three pairs that close together (**reading**).

What the field misses

The field asks how many electrons combine into one wave. The net reverses the order. The wave is not built from electrons. The electrons are crossings of one strand. What the experiment sees is where the strand closes on itself. A vortex, a rim current and a channel are all the same thing: a closed winding at a different depth.

Seen this way, the microscope will not show the wave “arising”. It will show where windows close and where they stay open. The prediction is concrete: supercurrent runs where closure is possible, at rims and in channels. Junctions sit at seams between domains of opposite direction.

The count

Two counts are ready. First, in the published π -junction curves, $|I_c|$ should touch zero at a single point, not over an interval. A zero that is a meeting, not a rest state, has no width. Second, in the SQUID maps of CsV_3Sb_5 , every junction should sit on a boundary between domains of opposite orientation. The new microscope gives both the current map and the domain map.

7. Thanja Lamberts — Chemistry without Heat

Leiden Institute of Chemistry and Leiden Observatory. Vidi project: computer simulations of how cosmic radiation drives chemical change in interstellar ice.

The work

The space between stars holds gas and small dust grains. In cold, dense clouds the grains carry a mantle of ice, up to about 100 molecular layers thick. The James Webb Space Telescope now measures the content of this ice: water, carbon monoxide, carbon dioxide and more (**source**).

At 10 K there is almost no thermal energy. Reactions still happen. Lamberts showed with quantum-chemical calculations that many of them run by tunnelling. Atoms pass through an energy barrier instead of over it (**source**).

With colleagues she modelled sulphur chemistry in ice with two changes. First, cosmic rays drive radiation chemistry inside the ice. Second, radicals inside the ice react with their direct neighbours without moving through the ice first.

With both changes the models produce much more S_8 — a ring of eight sulphur atoms — and less H_2S . S_8 is a candidate for the missing sulphur reservoir in dense clouds (**source**).

The open problem

How cosmic radiation drives chemical change in icy grains is not well understood. The Vidi project will simulate it, to find out how the building blocks of planets and life arise in space.

What the net shows

At 10 K, only neighbours react. Without heat, nothing travels far through the ice. A radical meets only what is already next to it. This is the window in its purest form: three crossings that follow each other along the strand, with no mixing from elsewhere. What closes in that window stays. What does not close stays as tension, waiting for a passage (**reading**).

Radiation is passage. By Section 2.8, passage per unit of time scales with one over the open size. A cosmic ray brings passage into a medium that has none of its own (**reading**).

The stable rings are closed counts. Sulphur forms rings of several sizes. The most stable is S_8 . Rings of S_6 and S_{12} are also well known and relatively stable. S_7 exists but is less stable (**source**). Write the sizes as products of 2 and 3: $6 = 2 \cdot 3$, $8 = 2^3$, $12 = 2^2 \cdot 3$. All three have the form $2^a \cdot 3^b$. The number 7 does not. Between 6 and 20, the sizes of this form are 6, 8, 9, 12, 16 and 18 (**counted**). The match of the three best-known stable rings is a correspondence, not yet a test.

What the field misses

The field models each reaction step with a rate. The rates come from barriers. At 10 K this approach meets two problems. Tunnelling makes rates extremely sensitive to the barrier shape. Non-diffusive reactions make the outcome depend on who happens to be a neighbour.

The net reads the same situation more simply. In the cold, selection is by fit alone. The products that remain are those that close. Radiation does not “drive” products. It supplies passage, and the ice keeps what closes. This changes what to look for in the simulations: not only rates, but which ring sizes and chain lengths persist.

The count

Two counts follow. First, list the ring and chain sizes that persist in the simulations and in the JWST ice spectra. Compare the share of sizes of the form $2^a \cdot 3^b$ with the share among all sizes in the same range. Second, by the passage rule, the yield of radiation products per unit of time should rise as ice layers get thinner. Lamberts’ simulations can vary the layer thickness directly.

8. Luuk Loeff — Defence that Reads Closure

Leiden University Medical Center. Vidi project: how bacteria recognise viral DNA by its structure. And how viruses escape this recognition.

The work

Loeff studies how bacteria defend themselves against viruses (phages). He combines single-molecule fluorescence, cryo-electron microscopy and biochemistry. Three results stand out (**source** for all).

1. **Cas3 reels DNA in steps of three.** In the CRISPR system of *E. coli*, the protein Cas3 stays attached to the Cascade complex and pulls the DNA in. It does so in bursts of 3 base pairs. Each burst consists of three single-nucleotide unwinding steps. The DNA often slips back and is reeled in again.
2. **DdmDE recognises a D-loop.** In *Vibrio cholerae*, DdmE uses a short DNA guide to open the target into a D-loop. DdmD is recruited only to that structure.
3. **Shedu recognises free DNA ends.** The protein SduA forms a clamp that grips open ends of double-stranded DNA. It nicks the DNA at a fixed distance from the 5' end. As a result, linear DNA cannot multiply in the cell. Phages escape by switching off their recombination-dependent replication.

The open problem

Most known defence systems read a sequence: a pattern of letters in the DNA. Some read the shape of the DNA instead. How bacteria recognise viral DNA by structure, and how viruses evade that recognition, is the Vidi question.

What the net shows

The host genome is a winding. The bacterial chromosome is a closed ring of DNA. Its ends are joined. Phage DNA that multiplies through a linear form has open ends. Shedu grips open ends and cuts. It removes what does not close and leaves what does. This is N2 in one protein: **what closes, stays; what does not close, is cut (reading)**.

The recognition needs no sequence at all. Self and non-self are separated by closure alone.

The escape is closure. The source states that phages escape Shedu by suppressing recombination-dependent replication — the route that produces linear, open-ended DNA. The phage survives by producing fewer open ends (**source**). In the net, this is the only kind of escape that can work against a closure reader: to close (**reading**).

Cas3 works in windows of three. Each burst of 3 bp is three single passages. Intermediate positions are not stable enough to be seen. The unit of work is a window of three (**counted** from the source).

What the field misses

The field treats structure recognition as a second, more exotic kind of pattern recognition. The net says it is the more basic kind. Sequence is content. Structure is closure. A defence that reads closure cannot be fooled by mutation, because changing letters does not close an open end.

This gives a prediction for the Vidi question. Phages escape structure-based defence by closing: by circularising their DNA, capping or protecting their ends, or avoiding linear intermediates. They do not escape by changing their sequence.

The count

In published and new escape mutants against Shedu, DdmDE and related systems, classify each escape. Does it reduce open ends or open loops? Or does it change sequence while the structure stays? The prediction is that escapes of the first kind dominate.

9. Annachiara Raia — A Story that Stays

African Studies Centre and Centre for the Arts in Society. Vidi project: how stories travel between island communities: Lamu, Madagascar and Java. The 3,000-year-old story of Joseph is at the centre.

The work

Raia's doctoral book, *Rewriting Yusuf*, studies the Swahili poem *Utendi wa Yusufu*. The poem retells the story of Joseph, son of Jacob. The story is told in Genesis, in the Qur'an (sura 12), and in the Arabic "Stories of the Prophets". The Swahili poem differs from all of them in its motifs and its style (**source**).

The poem is written in the *utendi* form. Each stanza has four lines of eight syllables. The first three lines rhyme with each other. The fourth line ends on a rhyme that stays the same through the whole poem, and ties all stanzas together (**source**).

Raia also works with the Lamu poet and imam Mahmoud Ahmed Abdulkadir (Ustadh Mau) and with print networks across the Indian Ocean (**source**).

The open problem

Stories are fragile. Manuscripts are lost, languages change, communities move. Yet some stories persist for thousands of years and across oceans. The Vidi project asks how stories travel, are retold and are shaped by place, and how they survive fragmentation.

What the net shows

A named story is a closure. In the theory, every distinction with an accepted name marks a closure. "The story of Joseph" is such a name. Its form changes on every island. The story stays (**reading**).

The story closes on return. Joseph is lost by his father. He goes down to Egypt, rises, and is reunited with his father and brothers. The story ends where it began: in the family. A story that ends with return is a winding: it returns on itself in phase (**reading**).

The utendi stanza has the two kinds of closure. Count the stanza. Four lines of eight syllables give $4 \times 8 = 32 = 2^5$ syllables (**counted**). The first three lines share one rhyme. Three equal values form a closed window of the first kind: sameness. The fourth line carries a rhyme that returns in every stanza. It runs through the whole poem like a strand that links all windows. Each stanza closes locally, and the poem closes as one (**reading**).

Scale. By N5, the same closure appears at every scale. A stanza closes. The poem closes. The story closes across versions. What does not close at one scale — a motif that is dropped, a local addition — is the material of the next retelling (**reading**).

What the field misses

The field explains persistence by transmission: networks of trade, religion, print and performance. These carry a story. They do not tell which stories survive the carrying. The net adds a selection rule. Stories that close — that return on themselves — persist. Forms that close at every level, like the *utendi*, hold a story together even when the chain of transmission breaks.

The count

In the corpus of stories shared between Lamu, Madagascar and Java, mark each story by its ending: return or no return. Mark also how many islands and how many centuries it reached. The prediction is that stories ending in return reach further. A second count: in each tradition, record the verse form and whether its stanzas close locally and globally.

10. Rachel Schats — Who the Plague Took

Faculty of Archaeology. Vidi project “Echoes of the Plague”: how plague outbreaks affected life in the Netherlands between 1350 and 1850. It combines human remains, ancient DNA and archives. It compares plague hospitals with ordinary cemeteries.

The work

Schats is an osteoarchaeologist. She reads disease and living conditions from bones. In her doctoral work she compared town dwellers of Alkmaar (1448–1572) with villagers from Blokhuizen and the drowned village of Klaaskinderkerke (**source**).

Two of the 189 Alkmaar skeletons showed lesions of tuberculosis on ribs and vertebrae. None of the 173 rural skeletons did. Only about 10% of tuberculosis patients develop bone lesions. Two cases in 189 is 1.06%. Divided by 0.10, that suggests about 10.6% of the town population had the disease (**counted** from the source figures). Town and village did not differ much in overall health. They faced different risks (**source**).

She later studied skeletal signs of malaria in medieval Dutch collections, and the infirmary of St. Gertrude in Kampen, with 89 skeletons from 2014 (**source**).

Historical work on the Dutch plague shows that it returned often until it disappeared in the late 1660s. It favoured dense towns, trade and war. In towns it often lingered for years in poorer neighbourhoods. Some local outbreaks killed about half the population (**source**).

The open problem

Who died in the plague epidemics, and why? How did disease, living conditions and inequality fit together? Why were some people more vulnerable than others?

What the net shows

A town is a dense mesh. By Section 2.8, passage per unit of time scales with one over the open size. A town has narrow meshes: short distances, many contacts, constant trade. It carries more passage per unit of time than a village. An infection is one form of passage (**reading**).

Vulnerability is a state, not a trait. By N4, a value such as mortality is not a fixed property of a disease. It is a property of the local state of the mesh. Poor neighbourhoods are a different state from rich ones. The same plague then has a different death rate (**reading**).

Earlier passages orient later ones. Bones record stress early in life: growth disruption in teeth, porous lesions in the skull. By N3, those first passages fix an orientation. A person whose early passages left marks of stress meets the plague in a different orientation than one whose did not (**reading**).

The echo. Plague lingered for years in poorer quarters. In the net, what does not close passes on as tension. A neighbourhood whose mesh stays open keeps the infection in passage (**reading**).

What the field misses

The field asks which individual factors — age, sex, status, diet, earlier disease — made someone vulnerable. These factors are real. But they are treated as separate causes that add up. The net reads them as one state of the mesh: density, poverty and earlier stress are three sides of the same local configuration.

This changes the comparison between plague hospital and cemetery. It is not a comparison of two groups of individuals. It is a comparison of two states of the same urban mesh.

The count

For each burial population, record the share of skeletons with early-life stress markers. The prediction from N3 is that the plague-hospital population shows more early stress than the ordinary cemetery of the same town and period. A second count, from the archives: the time an outbreak lingered in a quarter against the density of that quarter. The passage rule predicts longer lingering in denser, poorer quarters.

11. Jennifer Swerida — Oasis and Community as One

Faculty of Archaeology. Vidi project: how complex societies formed in unpredictable desert landscapes. The setting is the UNESCO site of Bat in Oman. Archaeology is combined with a new method to reconstruct short-term environmental change.

The work

Swerida directs the Bat Archaeological Project in north-western Oman. Bat is known for its Early Bronze Age tombs, round stone towers and settlements of the Umm an-Nar period, about 2700 to 2000 BC. That is 700 years (**counted**). In this period the region was known in Mesopotamian texts as Magan (**source**).

Her work shows three things (**source** for all):

1. **The oasis was made.** She treats the Bat oasis as a human-made space that developed together with the communities that used it.
2. **Settlement reached beyond the oasis.** Excavations in 2022–23 found Umm an-Nar occupation in three areas within about 10 km of the oasis centre, in different ecological zones.

3. **Pottery and towers form networks.** Comparison of pottery from houses and towers at Bat and Bisya shows patterns of use and exchange across the Hajar mountains.

Within the same landscape, land-snail shells were used as a climate archive. Their oxygen isotopes record wet and dry periods. The resulting series agrees with records from cave formations and ancient lakes (**source**).

The open problem

In many ancient deserts, water was unpredictable. Yet complex societies arose there. How did people adapt? The Vidi project combines archaeology with a method to reconstruct short-term environmental change, to see how social complexity formed under climatic uncertainty.

What the net shows

Oasis and community are one knot. Swerida's own framing already breaks the usual arrow. The oasis did not come first, with people adapting to it. Oasis and community formed together. In the net this is a constitutive relation: two quantities fixed together, without an arrow between them (**reading**).

Uncertainty is tension. An unpredictable climate is a strand that does not close by itself. By N2, what does not close passes on as tension. A society forms where that tension closes locally: where water, settlement and monument hold each other (**reading**).

The snail shell is memory. A shell grows in layers. Each layer records the water of its time. The layers are ordered. That is N3 made of calcium carbonate: ordered passages at one place (**reading**).

Wet, dry and the meeting point. Read the climate series as a register: wet (+1), dry (−1) and the transitions between them (0). By Section 2.5, the 0 is not a rest state. It is where the two directions meet (**reading**).

What the field misses

The language of "adaptation to" an environment assumes two separate actors: people and climate. The data from Bat do not support that split. The oasis is anthropogenic. The settlements reach into several zones. The monuments link communities. The net gives a frame in which this is the expected result: one knot, not a society responding to a backdrop.

The count

Place the phases of building at Bat — towers, tombs, houses — on the time axis of the snail record. The register gives a specific prediction: building phases cluster at the transitions between wet and dry regimes, not at the wet maxima. The comparison needs only the two dated series, which the project produces.

12. Anne Urai — Memory that Colours Reading

Institute of Psychology. Vidi project: whether expectations about social tipping points change behaviour. The tools are computer models, laboratory games and experiments.

The work

Urai is a cognitive neuroscientist. Her main finding concerns how earlier choices shape later ones. People and animals tend to repeat or alternate their previous choices, even when the stimuli are random. The question was where this bias enters the decision (**source**).

A standard model of decisions treats evidence as accumulating towards a bound. A bias could shift the starting point, or it could change the rate at which evidence accumulates. Across six data sets, with several task protocols and senses, Urai and colleagues found the same answer. Later work extended it across species. Choice history changes the *rate* of accumulation, not the starting point. The previous choice colours how new evidence is read (**source**).

Related work shows that people overweight evidence that agrees with an earlier choice (**source**). Persistent activity in the parietal cortex carries the earlier choice into the next decision (**source**).

In mice from the International Brain Laboratory, a hidden-state model found three discrete strategies. In one, the mouse follows the stimulus. In the other two, it leans to the left or to the right (**source**).

Urai also studies group choices on social issues, such as whether people pick a vegetarian meal when more colleagues do. She received the Heineken Young Scientists Award 2026 for Social Sciences (**source**).

The open problem

Social tipping points are sudden shifts in social norms. Experiments show such shifts once a committed minority reaches a critical size (**source**). The Vidi project asks whether the *expectation* of a tipping point makes people notice trends earlier and act on them — and so set off the tipping themselves.

What the net shows

Choice history is N3. The first passage fixes the orientation. Later passages are counted relative to it. Urai's result says exactly this: the earlier choice does not move the start, it changes how every later piece of evidence counts (**reading**).

Three strategies are the register. Follow the stimulus, lean left, lean right. That is 0, -1 and $+1$. The engaged state is the 0: the point where neither direction dominates (**reading**).

The observer is part of the strand. In the net, the observer is a knot. An expectation is not information about the strand from outside. It is a passage inside the strand. When expectation and trend-noticing go together, that is a constitutive relation: two quantities fixed together. The "self-fulfilling" character of social tipping is then not a paradox. It is closure through the observer (**reading**).

Tipping is silent, then steep. By Section 2.7, when the balance drifts towards one state, closure rises with the third power of the imbalance. For a while almost nothing changes. Then the change is fast. This is the shape of a social tipping point (**reading**, with the count in Section 2.7).

What the field misses

The field models expectation as an input to a decision process. That keeps the observer outside the system observed. The net puts the observer inside. Then the main question of the project has a direct answer: an expectation of tipping

is itself a passage that orients later passages, by N3. It does not need to be added to the model as an external belief.

The count

Two counts are ready. First, in human choice data, fit hidden-state models and count the strategies. The prediction is three: engaged, lean one way, lean the other. Second, in the laboratory games, record the share of players who adopt a new norm over time. Fit the onset against powers of time. The prediction is a cubic onset, as in Section 2.7.

13. Maartje Huijbers — One Target, Two Signs

Leiden University Medical Center. Vidi project: why severity and treatment response differ so much in autoimmune disease. The project analyses harmful antibodies and their effects, and builds a new model of chronic disease.

The work

Huijbers studies myasthenia gravis with antibodies against the protein MuSK. MuSK sits at the junction between nerve and muscle. With its partner LRP4, it organises the receptors that pick up the nerve signal (**source**).

Her main results (**source** for all):

1. **IgG4 is the harmful class.** In MuSK myasthenia the antibodies are mostly of the IgG4 subclass. IgG4 from patients transferred into mice causes myasthenia. IgG1-3 from the same patients does not.
2. **IgG4 blocks the partnership.** Patient IgG4 competes with the binding of MuSK to LRP4. Receptor clusters are lost and the junction breaks down.
3. **One arm blocks, two arms activate.** IgG4 swaps half of itself with other IgG4 molecules. It then carries two different arms and binds MuSK with one arm only. Such monovalent antibodies block agrin-induced MuSK signalling, with maximal inhibition at 7.7 nM. They block receptor clustering completely. In mice they cause rapid, severe weakness and a 20-30% drop in muscle response. The same antibodies with two identical arms do not block. They *activate* MuSK. One clone reaches more than the natural signal; another reaches about 70% of it.
4. **The clone matters.** One bivalent clone still caused weakness at higher doses, later and more slowly. The other caused none.
5. **Quantity does not explain severity.** Clinical severity depends on more factors than the amount of MuSK antibody. Raised total IgG4 in patients is not explained by the MuSK-specific antibodies.

At least a dozen other autoimmune diseases are dominated by IgG4 antibodies (**source**). A MuSK-activating antibody has been tested as a therapy in mouse models, with benefit that depends on the patient's antibodies (**source**).

The open problem

Many patients have severe symptoms despite treatment. Severity and response differ strongly between patients with the same disease and the same target. The field measures how much antibody a patient has. That does not explain the difference.

What the net shows

Valence is the register. Take one MuSK target and three possibilities:

- no antibody bound: 0;
- one arm bound, the neighbour free: the target is occupied but not bridged;
- two arms bound to two MuSK molecules: the two are bridged.

The two-armed antibody closes a bridge between two targets. Its sign is +1: it activates. The one-armed antibody occupies without closing. Its sign is −1: it blocks. The same molecule, at the same site, gives opposite signs depending on whether it closes (**reading**).

The sign depends on the state. One bivalent clone still harms, the other does not. By N4, the effect of a binding is not a fixed property of the antibody. It depends on where it binds and on the local configuration of MuSK and LRP4 (**reading**).

Quantity is the wrong measure. By N2, what matters is what closes. A high titer of antibodies that bridge acts differently from a high titer that only occupies. The titer adds both together and loses the sign (**reading**).

What the field misses

The field treats an autoantibody as harmful by its amount and its target. Huijbers' own data show that the same target and the same antibody can give opposite effects. The net makes this the central variable. Not *how much* binds, but *whether the binding closes*.

For the Vidi question this gives a direct lead. Patients differ in the share of their MuSK antibodies that are one-armed, in the sites those antibodies bind, and in how much bridging remains. That share, not the titer, should track severity and response to an activating therapy.

The count

For each patient, measure the MuSK-specific IgG4 that is one-armed (exchanged) and the share that can still bridge. Set the ratio against clinical severity and against response to therapy. The prediction is that the ratio tracks both better than the total titer.

14. Vincent van Unen — Inflammation that Holds Itself

Leiden University Medical Center. Vidi project: why intestinal inflammation does not stop in Crohn's disease and colitis. The focus is one group of immune cells, studied in biopsies, by single-cell analysis and in mini-guts.

The work

Van Unen was the first in the Netherlands to apply mass cytometry, which measures dozens of markers on single cells at once (**source**). His results (**source** for all):

1. **A map of the gut immune system.** In biopsies from patients with coeliac disease and Crohn's disease, mass cytometry revealed tissue- and disease-specific immune subsets.

2. **A network, not a cell.** In treatment-naive patients with inflammatory bowel disease, a 36-antibody panel separated 44 immune subsets. Inflammation went with a *network* of subsets: activated memory CD4 T cells, regulatory-like T cells, PD-1⁺ memory CD8 T cells, neutrophils, CD27⁺ $\gamma\delta$ T cells and NK cells. This network was present in some patients, independent of disease subtype, severity or location. It was confirmed in a second cohort.
3. **Three cell kinds together.** Imaging mass cytometry showed neutrophils, memory CD4 T cells and myeloid cells side by side in the inflamed gut.
4. **Memory before birth.** Memory CD4 T cells already form in the fetal gut.
5. **Mini-guts with three compartments.** His organoid models keep the epithelium, the supporting stroma and the native immune cells together.

The open problem

The number of people with Crohn's disease and colitis is rising worldwide. In many patients the gut stays inflamed despite treatment. Why does the inflammation not go out?

What the net shows

Persistence is closure. By N2, what closes, stays. Chronic inflammation is not an open process that fails to end. It is a configuration that has closed. It holds itself (**reading**).

The closure has three different roles. Neutrophils, memory T cells and myeloid cells sit together. They do different things. A window of three different values is the second kind of closure (Section 2.4). It is stable as a whole (**reading**).

Removing one member does not open it for long. A therapy that removes one cell type takes one value out of the window. The window becomes open, and what does not close passes on as tension. But the configuration is remembered (N3). A replacement of the same role re-closes the window. The network returns (**reading**).

Memory starts early. Memory T cells form before birth. By N3, the orientation of the gut immune system is set before the first exposure after birth (**reading**).

What the field misses

The field targets cell populations: reduce this subset, block that signal. Van Unen's own data say that inflammation is a network that is independent of subtype, severity and site. The net adds that the network persists because it closes. A therapy aimed at a population count leaves the closure in place.

His organoid model is the right test bed for this reason. It keeps epithelium, stroma and immune cells together: the smallest window of three roles in which closure can form and be broken.

The count

In imaging mass cytometry of biopsies, count triads: places where a neutrophil, a memory CD4 T cell and a myeloid cell sit together. Compare responders and non-responders to therapy. The prediction is that non-

responders keep their triads even when one of the three populations is reduced. In organoids, the same count can be made before and after removing one role.

15. Three Gaps

Set the eleven open problems side by side. Each one has the same structure. The project looks for the answer in a part: a particle, an enzyme, a protein, a cell type, a symptom, an antibody titer, a person, a settlement, a text. Each time, a property of the whole is left over. That remainder is always one of three kinds.

Gap	Axiom	Projects	What is left over
Form	N2 — closure	Lahabi, Loeff, Artola, Huijbers, Van Unen, Raia	what closes and what stays open
Order	N3 — memory	Knevel, Urai, Schats	how earlier passages orient later ones
State	N4 — context	Lamberts, Swerida, Schats, Huijbers	how a value depends on its surroundings

Schats and Huijbers appear twice. Their problems have two sides.

The three gaps are not weaknesses of the eleven researchers. They follow from the form of the question. A question of the type “which part causes this?” leaves the properties of the whole as a remainder by construction. Each researcher meets that remainder at the edge of a strong body of work. The Vidi texts name it honestly: *not understood, unclear, differs strongly, does not go out*.

Three findings recur across the eleven:

Selection by form, not by content. Shedu cuts open DNA ends without reading a sequence. Glycosidase inhibitors select by the shape they lock. MuSK antibodies change sign with the number of arms that bind. Supercurrent runs at rims and in channels. In each case the selection is by closure.

Three as the unit. Cas3 reels DNA in bursts of three single steps. Each enzyme route passes three shapes. The register appears as activate, nothing, block; as follow the stimulus, lean left, lean right; as positive, zero, negative critical current; as wet, transition, dry. Three-cell triads sit together in the inflamed gut. The utendi stanza closes on three equal rhymes.

Silent, then steep. The years before arthritis and the run-up to a social tipping point have the same shape. Section 2.7 shows that this shape follows from closure under drift: the excess grows with the third power of the imbalance.

16. The Human Layer

Behind each project are people.

Patients with early rheumatic disease spend years with vague complaints that nobody can place. If the signal lies in the order of their visits, not in any single test, those years can be shortened.

Patients with MuSK myasthenia have difficulty swallowing, speaking and breathing. Many need intensive care at some point. If severity tracks whether their antibodies close a bridge, not how many there are, treatment can be chosen per patient.

People with Crohn’s disease and colitis live with inflammation that returns after every treatment. If the inflammation holds itself as a triad of cell roles, the question for them changes from “which cell to remove” to “how to break the meeting”.

The plague victims of Leiden, Alkmaar and Kampen died in neighbourhoods. The people of Bat lived from water they could not predict. The poets of Lamu kept a story alive in a form that held it. Their lives are now evidence. Read with the net, that evidence shows how vulnerability, resilience and memory belonged to their place as much as to themselves.

17. The Eleven Counts

Each count needs only data the researchers publish or are about to produce.

Researcher	Count	Prediction
Artola	Itinerary per glycoside hydrolase family	Retaining: one ring there and back. Inverting: one route once
Knevel	Odds ratios over 6–72 months against powers of time	Exponent near 3
Lahabi	Shape of the zero in π -junction curves; junction positions in SQUID maps	Zero at a point; junctions on boundaries of opposite orientation
Lamberts	Persisting ring and chain sizes; product yield against layer thickness	Excess of sizes $2^a \cdot 3^b$; yield rises as layers thin
Loeff	Classification of escape mutants	Escapes reduce open ends rather than change sequence
Raia	Ending of each shared story against its reach	Stories ending in return travel further
Schats	Early-life stress markers in plague hospital vs cemetery	More early stress in the plague hospital
Swerida	Building phases against the snail climate series	Building clusters at wet-dry transitions
Urai	Number of hidden strategies in human data; onset of norm adoption	Three strategies; cubic onset
Huijbers	Share of one-armed MuSK IgG4 against severity and response	Ratio tracks both better than titer
Van Unen	Cell triads in imaging mass cytometry, responders vs non-responders	Non-responders keep their triads

18. Status of the Statements

Counted in this essay. The 27 windows and the 9 closed ones. The two kinds of closure. The two rings and the seam table. The closing probability under drift and its cubic excess. The share of 58% in the last 1.5 of 6 years under linear drift. The flux quantum and its half from CODATA values. The 10.6% estimate of tuberculosis in medieval Alkmaar. The sizes of the form $2^a \cdot 3^b$ between 6 and 20. The 32 syllables of the utendi stanza.

From the sources. All findings described as the work of the eleven researchers.

Readings. Every pairing between a finding and a part of the theory. None has yet been tested.

Open. The eleven counts of Section 17.

19. Conclusion

Eleven strong research lines in four faculties reach eleven open problems. The problems look unrelated. Read with the Vacuum.Net theory, they reduce to three: form, order and state. These are the three properties that a search for causes in parts leaves over.

The theory does not replace the eleven research programmes. It changes the question each one asks at its edge. Not “which part does this?”, but “what closes here, in what order, and in what state?” Each of the eleven can answer that question with its own data.

Annotated References

The theory

1. **Konstapel, J. (2026). *The Vacuum.Net Theory: Definition, Theorems and Tests*, version 4. Constable Research, Leiden, 17 October 2026.** <https://constable.blog/wp-content/uploads/vacuum-net-theory-v4.pdf> *Why read?* The formal statement used in Section 2: the five axioms, the proof that windows close only when all equal or all different, the closing probability under drift, and the rotor that needs 4π . Also lists every test made so far. *Reading advice:* Sections 2, 5.2 and Lemma 1.
2. **Konstapel, J. (2026). *Closure on a Ring: The Bethe Ansatz, the Work of J.-S. Caux, and the Closure Rule of the Vacuum.Net*. Constable Research, Leiden, 10 October 2026.** <https://constable.blog/2026/10/10/het-werk-van-prof-dr-j-s-jean-sebastien-caux-en-de-vacuum-net-theorie/> *Why read?* The fishnet picture, the left and right rings, and the seam table, worked out against exactly solvable chains in physics. A model for reading one researcher’s full publication list with the theory. *Reading advice:* Sections 1, 3 and 6.
3. **Konstapel, J. (2026). *One Direction or None: Mirror Molecules, the 2026 Nobel Prize in Chemistry and the Closure Rule of the Vacuum.Net*. Constable Research, Leiden.** <https://constable.blog/2026/10/10/one-direction-or-none-mirror->

molecules-the-2026-nobel-prize-in-chemistry-and-the-closure-rule-of-the-vacuum-net/ *Why read?* The two rings applied to chirality in chemistry. Background to the reading of Artola's two enzyme directions.

4. **Konstapel, J. (2026). *What Fits, Stays: Designer Molecules, the Closure Rule of the Vacuum.Net and Three Simple Roads to a Medicine*. Constable Research, Leiden.**
<https://constable.blog/2026/10/09/what-fits-stays-designer-molecules-the-closure-rule-of-the-vacuum-net-and-three-simple-roads-to-a-medicine/> *Why read?* Selection by fit applied to the work of the Overkleeft group, where Artola did her postdoctoral research.
5. **Hestenes, D. (1966). *Space-Time Algebra*. Gordon and Breach, New York.** *Why read?* Rotation as two reflections and the half-angle rotor behind Section 2.6. *Reading advice:* the chapter on rotations.
6. **Leiden University (22 October 2026). "Vidi-beurs voor elf onderzoekers van de Universiteit Leiden."** *Why read?* The eleven project descriptions in the words of the university. The source of every "open problem" in this essay.

Marta Artola Perez de Azanza

7. **Artola, M., Wu, L., Ferraz, M. J., et al., Davies, G. J., Overkleeft, H. S. (2017). "1,6-Cyclophellitol cyclosulfates: a new class of irreversible glycosidase inhibitor." *ACS Central Science* 3, 784-793.** <https://doi.org/10.1021/acscentsci.7b00214> *Why read?* The two conformational itineraries and the finding that a locked ⁴C₁ chair selects α -enzymes. *Reading advice:* Figure 1 shows both routes side by side.
8. **Beenakker, T. J. M., Wander, D. P. A., Offen, W. A., Artola, M., et al. (2017). "Carba-cyclophellitols are neutral retaining-glucosidase inhibitors." *Journal of the American Chemical Society* 139.** <https://doi.org/10.1021/jacs.7b01773> *Why read?* Inhibition by shape alone, without a reactive group.
9. **Davies, G. J., Rovira, C., Artola, M., et al. (2023). Article on an α -D-mannose-configured 1,6-trans-cyclic sulfamidate as a GH47 mannosidase inhibitor. *Chemical Science*.** <https://pubs.rsc.org/en/content/articlehtml/2023/sc/d3sc05016e> *Why read?* The one-way itinerary of an inverting enzyme family, for comparison with the retaining routes.
10. **Leiden University (2024). "How to hijack natural destruction in cells: we need to understand it through and through."** <https://www.universiteitleiden.nl/en/news/2024/09/how-to-hijack-natural-destruction-in-cells-we-need-to-understand-it-through-and-through> *Why read?* Artola's project on targeted degradation of Golgi enzymes, in plain language.
11. **CAZy — Carbohydrate-Active enZymes database.** <http://www.cazy.org> *Why read?* The classification of glycoside hydrolase families into retaining and inverting. The data for the count in Section 4.

Rachel Knevel

12. **Maarseveen, T. D., Meinderink, T., Reinders, M. J. T., et al., Knevel, R. (2020). "Machine learning electronic health record identification of patients with rheumatoid arthritis." *JMIR Medical***

Informatics 8, e23930. <https://doi.org/10.2196/23930> *Why read?* The pipeline that finds patients in free text, with its precision and speed.

13. **Maarseveen, T. D., Maurits, M. P., et al., Knevel, R. (2021).** **"Handwork vs machine."** *Arthritis Research & Therapy* **23**. <https://doi.org/10.1186/s13075-021-02553-4> *Why read?* How patient populations differ when selected by machine or by hand.
14. **Knevel, R., and Liao, K. P. (2023).** **"From real-world electronic health record data to real-world results using artificial intelligence."** *Annals of the Rheumatic Diseases* **82**, 306-311. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9933153> *Why read?* Knevel's view of what health-record data can and cannot show.
15. **van Beers-Tas, M. H., Nielen, M. M. J., Twisk, J. W. R., van Schaardenburg, D., et al. (2020).** **"Increased primary care use for musculoskeletal symptoms, infections and comorbidities in the years before the diagnosis of inflammatory arthritis."** *RMD Open* **6**, e001163. <https://rmdopen.bmj.com/content/6/2/e001163> *Why read?* The 4-6 year run-up and the odds ratios at 6, 12 and 18 months used in Section 5. *Reading advice:* the figure of consultation rates over time.
16. **Muller, S., et al. (2019).** **"Searching for a prodrome for rheumatoid arthritis in the primary care record."** *Seminars in Arthritis and Rheumatism*. <https://doi.org/10.1016/j.semarthrit.2018.06.008> *Why read?* The same pattern in British records: higher consultation rates for at least two years before suspicion.

Kaveh Lahabi

17. **Ryazanov, V. V., Oboznov, V. A., Rusanov, A. Yu., Veretennikov, A. V., Golubov, A. A., Aarts, J. (2001).** **"Coupling of two superconductors through a ferromagnet: evidence for a π junction."** *Physical Review Letters* **86**, 2427. <https://arxiv.org/abs/cond-mat/0008364> *Why read?* The critical current going through zero and changing sign. The data for the first count in Section 6.
18. **Lahabi, K., Amundsen, M., Ouassou, J. A., et al., Aarts, J. (2017).** **"Controlling supercurrents and their spatial distribution in ferromagnets."** *Nature Communications* **8**, 2056. *Why read?* Steering a supercurrent by moving a magnetic vortex.
19. **Yasui, Y., Lahabi, K., Anwar, M. S., et al., Aarts, J., Maeno, Y. (2017).** **"Little-Parks oscillations with half-quantum fluxoid features in Sr₂RuO₄ microrings."** *Physical Review B* **96** (18). <https://ss.scphys.kyoto-u.ac.jp/half-integer-quantum-fluxoid-state-in-sr2ruo4-microrings> *Why read?* The half-quantum states read in Section 6 as the seam.
20. **Blom, T. J., Rog, M., Altena, M., et al., Lahabi, K. (2025-2026).** **"Emergent network of Josephson junctions in a kagome superconductor."** [arXiv:2510.09777](https://arxiv.org/abs/2510.09777). <https://arxiv.org/abs/2510.09777> *Why read?* Shapiro steps and interference that reveal a junction network inside an unstructured flake.

21. **Rog, M., Blom, T. J., Regter, R. Q., et al., Allan, M. P., Lahabi, K. (2026). "Direct observation of channelised supercurrents in a kagome superconductor." arXiv:2606.20157.**
<https://arxiv.org/abs/2606.20157> *Why read?* The SQUID images of the channels, appearing at the critical temperature and staying. The closest thing to a picture of the strand. *Reading advice:* look at the current maps first.

Thanja Lamberts

22. **Shingledecker, C. N., Lamberts, T., Laas, J. C., Vasyunin, A., Herbst, E., Kästner, J., Caselli, P. (2020). "Efficient production of S₈ in interstellar ices." *The Astrophysical Journal* 888, 52.**
<https://arxiv.org/abs/1911.01239> *Why read?* Radiation chemistry and non-diffusive reactions in ice, and the S₈ ring as a result.
23. **Molpeceres, G., Kästner, J., Fedoseev, G., et al., Lamberts, T. (2021). "Carbon atom reactivity with amorphous solid water: H₂O-catalyzed formation of H₂CO." *Journal of Physical Chemistry Letters* 12, 10854-10860.** *Why read?* A reaction in which the ice itself takes part.
24. **Ferrari, B. C., Molpeceres, G., Kästner, J., et al., Lamberts, A. L. M. (2023). "Floating in space: how to treat the weak interaction between CO molecules in interstellar ices." *ACS Earth and Space Chemistry* 7, 1423-1432.** *Why read?* How weak neighbour interactions set what happens in cold ice.
25. **Leiden University. "Reactivity on interstellar ice analogues" (research project).** <https://universiteitleiden.nl/en/research/research-projects/science/reactivity-on-interstellar-ice-analogues> *Why read?* The programme in plain language, including the link to JWST.
26. **Steudel, R., and Eckert, B. (2003). "Solid sulfur allotropes." *Topics in Current Chemistry* 230, 1-79.** *Why read?* The full set of sulphur ring sizes and their stability. The source for the count in Section 7.

Luuk Loeff

27. **Loeff, L., Brouns, S. J. J., Joo, C. (2018). "Repetitive DNA reeling by the Cascade-Cas3 complex in nucleotide unwinding steps." *Molecular Cell* 70, 385-394.**
<https://www.biorxiv.org/content/10.1101/207886.full.pdf> *Why read?* The bursts of three base pairs, each made of three single steps. *Reading advice:* the step analysis.
28. **Loeff, L., Adams, D. W., Chanez, C., et al., Blokesch, M., Jinek, M. (2024). "Molecular mechanism of plasmid elimination by the DdmDE defense system." *Science* 385, 188-194.** *Why read?* Recognition of a D-loop structure rather than a sequence.
29. **Loeff, L., Walter, A., Rosalen, G. T., Jinek, M. (2025). "DNA end sensing and cleavage by the Shedu anti-phage defense system." *Cell* 188, 721-733.** <https://doi.org/10.1016/j.cell.2024.11.030> *Why read?* The clearest case in this essay: a defence that cuts what does not close, and phages that escape by producing fewer open ends.

30. **TU Delft (2018). "Cas3: a biological fishing rod and a shredder rolled into one."** <https://tudelft.nl/en/2018/tu-delft/cas3-a-biological-fishing-rod-and-a-shredder-rolled-into-one> *Why read?* The Cas3 result in plain language, including why slipping protects the host.

Annachiara Raia

31. **Raia, A. (2020). *Rewriting Yusuf: A Philological and Intertextual Study of a Swahili Islamic Manuscript Poem*. Köln: Rüdiger Köppe.** *Why read?* The Swahili Joseph poem against its biblical, Qur'anic and Arabic sources. *Reading advice*: the comparison chapters.
32. **Raia, A. (2018). "Swahili palimpsests: the Muslim stories beneath Swahili compositions." *Swahili Forum* 25.** *Why read?* How the stories of Jesus, Job and Joseph are rewritten in Swahili verse.
33. **Raia, A., and Vierke, C. (eds.) (2023). *In This Fragile World: Swahili Poetry of Commitment by Ustadh Mahmoud Mau*. Leiden: Brill.** *Why read?* A living poet's work and library on Lamu.
34. **Raia, A. (2023). "Transoceanic print histories: twentieth-century Swahili Muslim networks in the Indian Ocean." *Islamic Africa* 14, 55-78.** *Why read?* The networks along which texts travel across the ocean.
35. **"Utenzi." *Wikipedia*.** <https://en.wikipedia.org/wiki/Utenzi> *Why read?* A short description of the stanza form counted in Section 9.

Rachel Schats

36. **Leiden University (2016). "Middeleeuwse stedelingen niet slechter af dan dorpsbewoners."** <https://www.universiteitleiden.nl/nieuws/2016/11/middeleeuwse-stedelingen-niet-slechter-af-dan-dorpsbewoners> *Why read?* A summary of Schats' doctoral comparison of town and village, with the tuberculosis counts.
37. **Schats, R., and Klomp, M. (2019). "In sickness and in health: an archaeological and osteoarchaeological analysis of St. Gertrude's infirmary in Kampen (1382-c.1611)." In van Oosten, R., Schats, R., Fast, K. (eds.), *Osteoarchaeology in Historical Context*. Leiden: Sidestone Press, 105-120.** *Why read?* Whether hospital populations carry a signature of their own. The method behind the plague-hospital comparison.
38. **Leiden University (2021). "Skeletal evidence for malaria in the medieval Netherlands."** <https://www.universiteitleiden.nl/en/in-the-media/2021/06/medieval-malaria-skeletal-evidence-for-this-parasitic-infection-in-the-netherlands> *Why read?* Her previous NWO project, on another disease read from bones.
39. **Rommès, R. "Plague in Northwestern Europe: the Dutch experience, 1350-1670." *Popolazione e Storia*.** <https://popolazioneestoria.it/article/view/705> *Why read?* The pattern of Dutch plague: frequent return, lingering in poor quarters, local mortality up to half.

Jennifer Swerida

40. Swerida, J., Dollarhide, E. N., Jensen, R. (2021). "Settlement and chronology in the Early Bronze Age of southeastern Arabia: the view from Umm an-Nar period Bat, Oman." *Paléorient* 47(2), 75-96. *Why read?* The dated sequence of settlement at Bat.
41. Swerida, J., Dollarhide, E. N., Bryant, R. C., et al. (2025). "Results from beyond the oasis: excavations of the 2022-23 field season of the Bat Archaeological Project." *Journal of Oman Studies* 25, 28-57. *Why read?* Occupation in three zones within 10 km of the oasis.
42. Swerida, J., and Thornton, C. P. (2019). "al-Khafaji reinterpreted: new insights on Umm an-Nar monuments and settlement from Bat, Oman." *Arabian Archaeology and Epigraphy* 30, 157-172. *Why read?* The towers and their relation to settlement.
43. Swerida, J. (2022). *No Place Like Home: Ancient Near Eastern Houses and Households — Structure SS1 at Bat, Oman*. Oxford: Archaeopress. *Why read?* One house read in detail: the human scale of the Bat landscape.
44. "Unlocking the potential of the terrestrial gastropod species *Zootecus insularis* as a climate archive for arid regions." Johannes Gutenberg University Mainz. <https://openscience.ub.uni-mainz.de/handle/20.500.12030/12143> *Why read?* The snail-shell climate archive and its agreement with cave and lake records.

Anne Urai

45. Urai, A. E., de Gee, J. W., Tsetsos, K., Donner, T. H. (2019). "Choice history biases subsequent evidence accumulation." *eLife* 8, e46331. *Why read?* The central finding: history changes the rate, not the start. *Reading advice:* the model comparison figure.
46. Talluri, B. C., Urai, A. E., Tsetsos, K., Usher, M., Donner, T. H. (2018). "Confirmation bias through selective overweighting of choice-consistent evidence." *Current Biology* 28, 3128-3135. *Why read?* Evidence that agrees with an earlier choice counts more.
47. Urai, A. E., and Donner, T. H. (2022). "Persistent activity in human parietal cortex mediates perceptual choice repetition bias." *Nature Communications* 13, 6015. *Why read?* Where in the brain the earlier choice is carried forward.
48. Ashwood, Z. C., Roy, N. A., Stone, I. R., The International Brain Laboratory, Urai, A. E., Churchland, A. K., Pouget, A., Pillow, J. W. (2022). "Mice alternate between discrete strategies during perceptual decision-making." *Nature Neuroscience* 25, 201-212. *Why read?* The three hidden strategies: engaged, lean left, lean right. See also Urai's explanation at <https://anneurai.net/2024/01/26/a-glm-hmm-deep-dive/>
49. Centola, D., Becker, J., Brackbill, D., Baronchelli, A. (2018). "Experimental evidence for tipping points in social convention." *Science* 360, 1116-1119. *Why read?* The experiment in which a committed minority of critical size overturns a norm. The empirical base of the Vidi question.

Maartje Huijbers

50. Klooster, R., Plomp, J. J., Huijbers, M. G., et al. (2012). "Muscle-specific kinase myasthenia gravis IgG4 autoantibodies cause severe neuromuscular junction dysfunction in mice." *Brain* 135, 1081-1101. *Why read?* IgG4, and not IgG1-3, carries the disease.
51. Huijbers, M. G., Zhang, W., Klooster, R., et al. (2013). "MuSK IgG4 autoantibodies cause myasthenia gravis by inhibiting binding between MuSK and LRP4." *PNAS* 110, 20783-20788. *Why read?* The broken partnership between MuSK and LRP4.
52. Vergoossen, D. L. E., et al., Huijbers, M. G. (2021). "Functional monovalency amplifies the pathogenicity of anti-MuSK IgG4 in myasthenia gravis." *PNAS* 118, e2020635118. <https://doi.org/10.1073/pnas.2020635118> *Why read?* The key result for Section 13: one arm blocks, two arms activate, and the clone matters. *Reading advice:* the comparison of monovalent and bivalent forms in cells and in mice.
53. Huijbers, M. G. M. (2016). *The Pathophysiology of MuSK Myasthenia Gravis*. PhD thesis, Leiden University. <https://hdl.handle.net/1887/41483> *Why read?* The full line of work, and the observation that severity depends on more than antibody quantity.
54. Vergoossen, D. L. E., Ruiter, A. M., Keene, K. R., et al. (2022). "Enrichment of serum IgG4 in MuSK myasthenia gravis patients." *Journal of Neuroimmunology* 373, 577978. *Why read?* Total IgG4 does not explain the MuSK response.
55. "Patient-specific therapeutic benefit of MuSK agonist antibody ARGX-119 in MuSK myasthenia gravis passive transfer models." <https://doaj.org/article/b344c5946ce444ea99ddc93f9d023e1e> *Why read?* An activating antibody as therapy, with a benefit that depends on the patient's own antibodies.

Vincent van Unen

56. van Unen, V., Li, N., Molendijk, I., et al., Koning, F. (2016). "Mass cytometry of the human mucosal immune system identifies tissue- and disease-associated immune subsets." *Immunity* 44, 1227-1239. *Why read?* The first system-wide map of gut immune cells in disease.
57. van Unen, V., Ouboter, L. F., Li, N., et al., Koning, F. (2022). "Identification of a disease-associated network of intestinal immune cells in treatment-naïve inflammatory bowel disease." *Frontiers in Immunology* 13, 893803. <https://doi.org/10.3389/fimmu.2022.893803> *Why read?* The 44 subsets, the network, and the three cell kinds side by side. The data behind Section 14. *Reading advice:* the correlation network and the imaging figure.
58. Li, N., van Unen, V., Abdelaal, T., et al., Koning, F. (2019). "Memory CD4⁺ T cells are generated in the human fetal intestine." *Nature Immunology* 20. *Why read?* Immune memory before birth.
59. van Unen, V. (2018). *Mucosal Immunology Revisited through Mass Cytometry: From Biology to Bioinformatics and Back*. PhD thesis, Leiden University. *Why read?* The methods, including the analysis of millions of single cells.

