

The Climate on the Ladder of Three

Layers, Closure and the Three Families of the Vacuum.Net

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Abstract

The Vacuum.Net theory writes every place in the net as a depth plus a number in balanced ternary. This essay takes that register at its word. It derives the full list of layers from the trit, from depth 0 to depth 306. It gives each layer a length and a time from the natural units. It then names what is found at each layer, from a virus at depth 0 to the observable universe at depth 71.

The climate is placed on that list. In space it occupies five layers, 22 to 26. Its radiation sits on layer 5. Its rhythms occupy the layers 43 to 58. The closure rule of the net is then applied to neighbouring layers. One result follows in three lines: in a closed chain every third layer carries the same state. The layers fall into three families. Two are free. The third follows.

The weather layer is the one that follows. The ground, the orbit, the inner core, the Sun and the centre of the Milky Way fall in one family. Water falls in the second. The essay ends with three measurements on public data that count how often the windows close. Every step is written out with its numbers. No reference needs to be opened to follow it.

1. The image and the question

The image is a fishnet in water. Its strands run everywhere and are always under tension. Where strands wind around each other, knots appear. Between strands lie meshes. A winding persists only if it returns in phase inside its mesh. What does not fit does not stay.

The climate debate reads one number, the concentration of carbon dioxide. It says little about where the climate sits in the whole. The question of this essay is plain. On which layers of the net does the climate lie, and what does the net's own rule say about those layers?

The question came with a second one. The cycles of the climate seem to run from the core of the Earth to the black hole at the centre of the galaxy. Is there a relation between those cycles and the trit? The essay answers both with one list.

2. The register and the rule

The theory rests on five axioms.

- **N1, Strand.** There is one strand. Every distinction is the strand touching itself.
- **N2, Closure.** A configuration persists only if it closes on itself.
- **N3, Memory.** The net keeps the orientation of what was first laid down.
- **N4, Context.** Constants are state functions of the local vacuum.
- **N5, Scale.** The same winding appears at every depth.

From N1 and N3 follows a three-valued state per crossing: +1, 0, −1. The strand passes over, passes under, or does not cross. This is the trit. An address in the net is a depth plus a number in balanced ternary. Every integer has exactly one such address.

The closure rule works on a window of three neighbours. The window is closed when the three trits add to 0, counted modulo 3. Of the 27 possible triples, 9 are closed. Six hold all three values. Three hold the same value three times. With two neighbours fixed, exactly one value closes the window.

The natural units are those of Larson. The unit of time is one half-period of the Rydberg frequency, $T_0 = 1.521 \times 10^{-16}$ s. The unit of space is that time multiplied by the speed of light, $S_0 = 45.6$ nm.

3. The layers, derived

Nine steps lead from the trit to the list.

1. **Register.** One trit per crossing: +1, 0, −1.
2. **Layer.** An address is a depth plus a number. Each depth n is one layer. A layer holds n trits.
3. **States.** Layer n has 3^n states. Layer 5 has 243.
4. **Range.** The largest number at depth n is $(3^n - 1)/2$. For $n = 1$ to 6 this gives 1, 4, 13, 40, 121, 364. A larger number forces the next depth.
5. **Addresses.** An address is a period without a starting point. Rotations of one string are one address. The count is the necklace number $g(n) = (1/n) \cdot \sum \phi(n/d) \cdot 3^d$, summed over the divisors d of n . For $n = 1$ to 6 this gives 3, 6, 11, 24, 51, 130.
6. **Closed window.** Three neighbours close when their sum is 0 modulo 3.
7. **Closed ring.** Section 3.1 derives which rings close completely.
8. **Scale.** N5 gives a factor 3 per layer. Layer n has the time $3^n \cdot T_0$ and the length $3^n \cdot S_0$.
9. **Closure depths.** Section 3.2 derives where the ladder of three meets the ladder of two.

3.1 Which rings close completely

Take a ring of n trits and ask that every window is closed. Two neighbouring windows give two equations:

$$T(i-1) + T(i) + T(i+1) = 0 \text{ and } T(i) + T(i+1) + T(i+2) = 0.$$

Subtract the first from the second. What remains is $T(i+2) = T(i-1)$. Every trit equals the trit three places back. A fully closed ring has period 3.

Two cases follow. If n is divisible by 3, the first two trits are free and the third is fixed. That gives $3 \times 3 = 9$ closed rings. If n is not divisible by 3, period 3 and period n together force period 1. Only the three uniform rings remain: all +1, all 0, all −1.

So a ring can close with all three values only at depths divisible by 3. The count was checked by listing every ring for $n = 3$ to 9. It gives 9, 3, 3, 9, 3, 3, 9.

3.2 Where three meets two

The address ladder triples. The dimensional ladder of the theory doubles: 1, 2, 4, 8. The two never coincide, because $\log_2 3 = 1.58496\dots$ is irrational. They come close where $3^q \approx 2^p$. Those places are the convergents of the continued fraction of $\log_2 3$: $2/1, 3/2, 8/5, 19/12, 65/41, 84/53, 485/306$.

The denominators are the closure depths. The quotient $3^q / 2^p$ is the residue, the part that does not close.

Depth q	$3^q \approx 2^p$	Residue	Time $3^q \cdot T_0$	Length $3^q \cdot S_0$
1	$3^1 \approx 2^2$	0.7500 0	0.46 fs	136.8 nm
2	$3^2 \approx 2^3$	1.1250 0	1.37 fs	410.4 nm
5	$3^5 \approx 2^8$	0.9492 2	37.0 fs	11.08 μm
12	$3^{12} \approx 2^{19}$	1.0136 4	80.8 ps	24.23 mm
41	$3^{41} \approx 2^{65}$	0.9886 0	92.4 min	11.12 AU
53	$3^{53} \approx 2^{84}$	1.0020 9	93.4 y	93.4 ly
306	$3^{306} \approx 2^{485}$	0.9989 8	4.8×10^{122} y	4.8×10^{122} ly

At depth 12 the residue is 1.01364. That is the Pythagorean comma. Two of the seven closure depths are divisible by 3: depth 12 and depth 306. There both kinds of closure coincide.

4. The layers, named

Each layer has a length and a time. The next step is to write beside each layer what is found at that size and what lasts that long. Appendix A gives the full table for the layers 0 to 71. Each name carries its measured value, so that the distance to the layer can be read off. A selection:

n	Length	What has that size	Time	What lasts that long
0	45.6 nm	Small virus	0.15 fs	Orbit of the electron in hydrogen
2	410 nm	Violet light, hydrogen line H δ	1.4 fs	Oscillation of visible light
5	11.1 μm	Heat radiation of the Earth; body cell	37 fs	Bending vibration of molecules
16	1.96 m	The human body	6.5 ns	–
24	12.9 km	Height of the weather layer	43 μs	–
28	1,043 km	Inner core of the Earth	3.5 ms	–
30	9,389 km	The Earth	31 ms	Fast brain rhythm
33	253,493 km	Orbit of the Moon	0.85 s	Heartbeat
34	760,480 km	The Sun	2.5 s	One breath
41	11.1 AU	Orbit of Saturn	92 min	Sleep cycle
51	10.4 ly	Nearest stars	10.4 y	Sunspot cycle
53	93.4 ly	Nearest star cluster	93.4 y	Long solar cycle; a human life
58	22,700 ly	Centre of the Milky Way	22,700 y	Precession of the Earth's axis

70	12.1 billion ly	Hubble radius	12.1 billion y	Age of the universe
71	36.2 billion ly	Observable universe	36.2 billion y	–

Two things stand out. The human body sits at depth 16 in length. Its rhythms sit at depths 30 to 34 and 41 in time: brain rhythm, heartbeat, breath, sleep. And the ladder reaches the observable universe at depth 71.

The layers 72 to 306 carry no known phenomenon. They lie beyond what has been observed. Closure depth 306 lies in that range.

One identity is exact. The hydrogen line $H\delta$, the jump from level 6 to level 2, has the wavelength $9/(2R)$, with R the Rydberg constant. Since $S_0 = 1/(2R)$, that is $3^2 \cdot S_0$. It follows from $1/4 - 1/36 = 2/9$. Closure depth 2 is a spectral line.

5. Where the climate sits

The position of a phenomenon on the ladder is $\log_3$ of its size over S_0 , or of its duration over T_0 . The nearest whole number is its layer.

5.1 In space

Phenomenon	Size	Position	Layer
Lowest air layer, the ground where people live	1.5 km	22.04	22
Mean depth of the ocean	3.7 km	22.86	23
Top of the weather layer	12 km	23.94	24
Continental crust; ozone layer	35 km	24.91	25
Edge of the atmosphere	100 km	25.87	26

The climate is the shell of the Earth. It occupies five consecutive layers. The Earth itself lies at layer 30, its outer core at 29, its inner core at 28.

5.2 In radiation

Layer 5 has the length $11.08 \mu\text{m}$. That is the centre of the window through which the Earth loses its heat, 8 to $13 \mu\text{m}$. The ozone band at $9.6 \mu\text{m}$ lies at position 4.87. The carbon-dioxide band at $15 \mu\text{m}$ lies at position 5.28. Both belong to layer 5. Layer 5 is a closure depth.

5.3 In time

Phenomenon	Duration	Position	Layer
Tide	12.42 h	42.90	43
Weather system	5 d	44.96	45

Spring tide	14.77 d	45.95	46
Tropical oscillation	45 d	46.96	47
Solar rhythm	154 d	48.08	48
Year	365.24 d	48.87	49
El Niño	3.5 y	50.01	50
Sunspot cycle	11.0 y	51.05	51
Orbit of Saturn	29.46 y	51.95	52
Long solar cycle	88 y	52.95	53
Solar cycle of 208 y	208 y	53.73	54
Solar cycle of 1,000 y	1,000 y	55.16	55
Solar cycle of 2,300 y	2,300 y	55.92	56
Precession	25,772 y	58.12	58

In space the climate lies on layers 22 to 26. In time it lies on layers 43 to 58. Those are two different stretches of the ladder. The layers 43 to 58 have, in length, the size of the solar system up to the centre of the galaxy. Layer 58 holds both the precession of the Earth's axis and the distance to the galactic centre. The rhythms of the climate do run from the Earth to the central black hole.

6. The closure step

Now the closure rule is applied to the layers themselves. Each layer carries one trit, its state. Three neighbouring layers form a window.

The derivation is that of Section 3.1, read along the ladder.

1. Window n closes: $T(n-1) + T(n) + T(n+1) = 0$.
2. Window $n+1$ closes: $T(n) + T(n+1) + T(n+2) = 0$.
3. Subtract: $T(n+2) = T(n-1)$.

In a closed chain every third layer carries the same state. The layers fall into three families by their number modulo 3.

- **Family A:** $n = 1$ modulo 3.
- **Family B:** $n = 2$ modulo 3.
- **Family C:** $n = 0$ modulo 3.

Two families are free. The third follows: $C = -(A + B)$.

6.1 The climate in space

Layer	What lies there	Family
22	Lowest air layer, the ground	A
23	Water, the depth of the ocean	B
24	Weather layer	C

25	Crust, ozone layer	A
26	Edge of the atmosphere	B

The weather layer is the dependent one: $T(24) = -(T(22) + T(23))$. The state of the weather follows from the state of the ground and the state of the water.

6.2 The climate in time

Family	Layers	What lies there
A	43, 46, 49, 52, 55, 58	Tide, spring tide, year, Saturn, 1,000 y, precession
B	44, 47, 50, 53, 56	Tropical oscillation, El Niño, long solar cycle, 2,300 y
C	45, 48, 51, 54, 57	Weather system, 154 days, sunspots and Jupiter, 208 y

The division comes from the layer number alone. Family A turns out to hold orbit and axis. Family B holds the slow swings of ocean and Sun. Family C holds weather and sunspots. Again the weather is in the family that follows.

6.3 The three centres

Centre	Size	Position	Layer	Family
Inner core of the Earth	1,220 km	28.14	28	A
Sun	696,340 km	33.92	34	A
Centre of the Milky Way	26,670 ly	58.15	58	A

The three centres fall in one family. They share it with the ground at layer 22 and with year and precession. The outer core at layer 29 falls in B, with the water at layer 23. The Earth as a whole at layer 30 and the orbit of the Moon at layer 33 fall in C. The radiation layer 5 falls in B.

7. What the families say

The weather is not a control. It is the layer that follows. In the closed chain it has no freedom of its own. It is what remains when the two other families have their state.

Two things set it, and one is within reach. Family A is orbit, axis, core, Sun and galactic centre. That state is given. Family B is water: the ocean, El Niño, the slow swings. At the scale of a village that is ditch, water level, soil and groundwater. There the state can be set. Restoring balance is a matter of water. This is not a preference. It is the place of water in the chain.

Sun and weather correspond. Sunspots and weather systems lie in the same family and carry the same state. Neither sets the other. It is the same winding at two depths.

The centres and the ground belong together. Inner core, Sun, galactic centre and the ground on which people live lie in one family. The core is the beginning, not a detail.

Carbon dioxide is part of layer 5. Its band lies inside the radiation layer, beside the ozone band. Layer 5 falls in family B, the family of water. Water vapour sets the short-wave edge of that window, below $8\ \mu\text{m}$. The concentration of carbon dioxide is then a reading of the state of that layer.

8. The half-step family

One group of cycles does not lie on a layer. It lies exactly between two. The positions below use the current value of the Rydberg constant, $T_0 = 1.51983 \times 10^{-16}\ \text{s}$.

Cycle	Duration	Position
Day	86,400 s	43.4999
Rotation of Venus	243.0226 d	48.5000
Beat of the two lunar months	2,190.35 d	50.5013
Saros	6,585.32 d	51.5033
Triple Saros	19,755.96 d	52.5033

Among themselves these five lie whole powers of 3 apart: 3^0 , 3^5 , 3^7 , 3^8 and 3^9 days. The residues against the day are 0.009% for Venus, 0.15% for the lunar beat and 0.37% for the Saros. As a group they lie one half layer, a factor $\sqrt{3}$, off the ladder that starts at T_0 . The day lies 0.013% from $3^{43.5} \cdot T_0$.

The lunar beat follows from two lunar cycles. The line of apsides turns in 8.85 years, the line of nodes in 18.61 years. Then $1/8.85 + 1/18.61 = 0.1667$ per year, a period of 6.00 years. The six-year oscillation in the length of day, read as a signal of the core, has a measured period of 5.9 years. Core and Moon share one clock.

The ladder as derived does not yet give the half step. It is recorded here as measured.

9. The human layer

Layer 22 is where people live: the ground and the first kilometre of air above it. Layer 23 is the water beneath and beside them. A farmer, a water board and a village can set the state of layer 23 on their own land. They can screen a ditch, raise a water level, keep water on the soil.

Peat shows what that does. Drained peat releases carbon and sinks. Raising the water table by 10 cm lowers the emission by about 3 tonnes of carbon dioxide per hectare per year (Evans and others, 2021). The same act holds the water, keeps the soil, and cools the air above the field in summer. People who live there see it within a season. They see the ground stop sinking.

The chain says the same in its own terms. The weather layer follows from ground and water. Whoever sets the water sets one of the two free states.

10. Three measurements

The closure rule can be counted. Each layer gets a measured series. Each month becomes a trit: +1 when the series rises, 0 when it turns, −1 when it falls. Per month the three neighbouring trits are added. The count is how often the sum is 0 modulo 3. By chance that is one third. The comparison is the same series, shuffled in time. Claude Code runs all three.

Measurement 1, the time chain. Layer 49 is the seasonal course of temperature. Layer 50 is the El Niño index of the Pacific. Layer 51 is the monthly sunspot number. Claude Code counts the closed months of the window (49, 50, 51) since 1870.

Measurement 2, ground, water and weather at one place. Layer 22 is the temperature just above the ground. Layer 23 is the groundwater level in a monitoring well. Layer 24 is rainfall or air pressure at the nearest station. Claude Code counts how often $\text{weather} = -(\text{ground} + \text{water})$, for one well in a peat-meadow area. This is the measurement that people on the spot can follow themselves.

Measurement 3, the same family. Layers three apart carry the same state. Claude Code compares El Niño (50) with the long solar cycle (53), and sunspots (51) with the solar rhythm of 154 days (48).

11. Status

- **Taken from the sources.** The five axioms, the trit, the unique address, the closure rule on a window, the natural units, the closure depths.
- **Derived.** The list of layers with states, range, addresses, time and length. The period-3 theorem for closed rings and the count of 9 or 3. The three families and the rule $C = -(A + B)$. The identity $H\delta = 3^2 \cdot S_0$.
- **Corresponded.** The name beside each layer. A phenomenon is placed on the nearest layer; its measured value stands beside it. The membership of the three centres, of ground, water and weather, and of the climate rhythms follows from that placement.
- **Checked against measurement.** The positions of day, Venus, lunar beat and Saros at $n + \frac{1}{2}$. The lunar beat of 6.00 years against the 5.9 years of the core.
- **Open.** The half step of $\sqrt{3}$. The states of the layers today, and with them which windows are open. The three measurements of Section 10. The layers 72 to 306.

Appendix A. The layers 0 to 71

A star marks a closure depth. A dash means that no phenomenon of that duration is known.

n	Fa mil	Leng th	What has that size	Time	What lasts that long
0	C	45.6	Small virus (hepatitis B, 42 nm); closure depth (45.6 fs)	0.15 fs	Orbit of the electron in hydrogen (0.152 fs)
1 *	A	136.8 nm	Far ultraviolet, stopped by oxygen (130–175 nm); large virus (120 nm)	0.46 fs	Oscillation of far-ultraviolet light
2 *	B	410.4 nm	Violet light; hydrogen line H δ (410.3 nm); smallest bacterium (300 nm)	1.37 fs	Oscillation of visible light
3	C	1.2	Near infrared; bacterium (1–2 μ m)	4.11 fs	Oscillation of near-infrared light
4	A	3.7	Infrared window 3–4 μ m; cell closure (3.7 μ m)	12.32 fs	Stretch vibration of molecules (O–H 9 fs, C–O 14 fs)
5 *	B	11.1 μ m	Heat radiation of the Earth (window 8–13 μ m, ozone 9.6 μ m, CO ₂ 15 μ m)	36.96 fs	Bending vibration of molecules (ozone 32 fs, CO ₂ 50 fs)
6	C	33.2	Far infrared; pollen grain (30 μ m)	110.8 fs	Vibration of hydrogen bonds in water (110–170 fs)

7	A	99.7 μm	Terahertz radiation; human egg cell (100–120 μm); width of a hair	332.6 4 fs	Rotation of small molecules
8	B	299.2	Submillimetre radiation; dust mite	997.9	Lifetime of a hydrogen bond in water
9	C	897.5 μm	Background radiation of the universe (peak 1.06 mm); grain of sand	2.99 ps	Rearrangement of water
10	A	2.7	Millimetre waves; head of an ant	8.98	Relaxation of water (8.3 ps)
11	B	8.1	Microwaves 37 GHz; raindrop (2–5 μm)	26.94	–
12	C	24.2 mm	Microwaves 12.4 GHz; width of a thumb	80.83 ps	–
13	A	72.7	Microwaves 4.1 GHz; hen's egg (6 cm)	242.5	–
14	B	218.1	Hydrogen line of 21.1 cm; human	727.4	Oscillation of the hydrogen line (0.704 ns)
15	C	654.3	Radio waves 458 MHz; arm length, 1.7 m	2.18	Afterglow of molecules (1–10 ns)
16	A	1.96	Height of the human body (1.6–2.0 m)	6.55	–
17	B	5.89	Giraffe (5.5 m); a room	19.64	Lifetime of the pion (26 ns)
18	C	17.67	Large tree; blue whale (25 m)	58.93	–
19	A	53.00	Short-wave radio; tall tree (50 m)	176.7	–
20	B	159.0	Tallest trees (115 m); Great Pyramid (130 m)	530.3	–
21	C	476.9	Medium-wave radio; a hill	1.59	Lifetime of the muon (2.2 μs)
22	A	1.4	Lowest air layer, cloud base (1–2 km)	4.77	–
23	B	4.3	Mean depth of the ocean (3.7 km); a football field	14.32	Fastest folding of a protein
24	C	12.9	Height of the weather layer (6–17 km)	42.96	–
25	A	38.6 km	Ozone layer (20–50 km); continental crust (35 km)	128.8 7 μs	–
26	B	115.9 km	Edge of the atmosphere (100 km); lower ionosphere	386.6 2 μs	–
27	C	347.7	Upper ionosphere (250–400 km)	1.2	Nerve pulse (about 1 ms)
28	A	1,043.2 km	Inner core of the Earth (radius 1,220 km)	3.5 ms	–
29	B	3,129.5 km	Outer core of the Earth (radius 3,480 km); mantle (2,890 km thick); Moon	10.4 ms	–
30	C	9,388.6 km	The Earth (radius 6,371 km, diameter 12,742 km)	31.3 ms	Fast brain rhythm (30–40 Hz); Crab pulsar (33 ms)
31	A	28,165.9	Circumference of the Earth (40,075 km); radiation belts	93.9 ms	Alpha rhythm of the brain (8–12 Hz); ground tone of the cavity between
32	B	84,497.7	Magnetic field of the Earth on the day side (64,000 km); Jupiter (radius 71,492 km)	281.8 ms	Reaction time; eye movement
33	C	253,493.2	Orbit of the Moon (384,400 km)	845.5 ms	Heartbeat (71 per minute)
34	A	760,479.5	The Sun (radius 696,340 km)	2.54 s	One breath (3–5 s)
35	B	0.02 AU	Two to three solar diameters	7.61	Ocean swell (7–10 s); blood-pressure
36	C	0.05 AU	Corona of the Sun (10–20 solar radii)	22.83	Long earthquake waves (20 s)
37	A	0.14 AU	Inner solar wind	1.1	Pulsations of the Earth's magnetic field (45–150 s)

38	B	0.41 AU	Orbit of Mercury (0.39 AU)	3.4 min	Three-minute oscillation of the Sun
39	C	1.24 AU	Orbits of Earth and Mars (1.0 and 1.5 AU)	10.3 min	Granulation of the solar surface (8–10 min); light from Sun to Earth (8.3 min)
40	A	3.71 AU	Asteroid belt to Jupiter (2.1–5.2 AU)	30.8 min	Innermost orbit around the central black hole (32.6 min); tsunami (10–60 min)
41	B	11.12 AU	Orbit of Saturn (9.6 AU)	1.54 h	Human sleep cycle (90 min); orbit just above the Earth (84–93 min)
42	C	33.35 AU	Neptune and the Kuiper belt (30–50 AU)	4.62 d	–
43	A	100 AU	Edge of the solar wind (85–120 AU)	13.87 d	Half a day; tide (12.42 h)
44	B	300 AU	Scattered disc (several hundred AU)	1.7 d	Orbit of Io (1.77 d)
45	C	901 AU	Farthest point of Sedna (about 940 AU)	5.2 d	Five-day wave of the atmosphere; time from sunset to sunrise
46	A	2,702 AU	Inner Oort cloud	15.6 d	Half a month; spring tide (14.8 d)
47	B	0.1 ly	Oort cloud	46.8 d	Tropical oscillation of 30–60 days
48	C	0.4 ly	Outer Oort cloud	140.4 d	Solar rhythm of 154 days
49	A	1.2 ly	Edge of the Sun's reach (1–2 ly)	1.2 y	Year (365.24 d); wobble of the Earth's axis (423 d)
50	B	3.5 ly	Distance to the nearest star (4.25 ly)	3.5 y	El Niño (2–7 y)
51	C	10.4 ly	Nearest stars (Sirius 8.6 ly; Epsilon Centauri 10.5 ly)	10.4 y	Sunspot cycle (11 y); orbit of Jupiter (11.86 y)
52	A	31.1 ly	Nearby stars (Vega 25 ly, Arcturus 37 ly)	31.1 y	Orbit of Saturn (29.5 y); a generation
53	B	93.4 ly	Nearest star cluster (Hyades, 153 ly)	93.4 y	Long solar cycle (80–100 y); a human life
54	C	280.3 ly	Local Bubble in the gas between the stars (radius 300–500 ly)	280.3 y	Orbit of Pluto (248 y); solar cycle of 208 y
55	A	840.8 ly	Nearest star-forming regions (Orion, Taurus)	840.8 y	Solar cycle of about 1,000 y
56	B	2.5 thous and	Thickness of the disc of the Milky Way (2,000–2,600 ly)	2.5 thous and y	Solar cycle of 2,300–2,500 y
57	C	7.6 thous and	Distance to the next spiral arm (6,400 ly)	7.6 thous and y	–
58	A	22.7 thous and	Distance to the centre of the Milky Way (26,670 ly)	22.7 thous and y	Precession of the Earth's axis (25,772 y; climate 19,000–23,000 y)
59	B	68.1 thous and	Disc of the Milky Way (radius 50,000 ly)	68.1 thous and y	–
60	C	204.3 thous and	Magellanic Clouds (160,000–200,000 ly)	204.3 thous and y	Reversal of the Earth's magnetic field (mean 200,000–300,000 y)
61	A	613.0 thous and	Halo of the Milky Way	613.0 thous and y	Shape of the Earth's orbit (405,000 y)
62	B	1.8 millio	Distance to Andromeda (2.5 million ly)	1.8 milli	Ice-age period (2.6 million y)
63	C	5.5 millio	Local Group (radius 5 million ly)	5.5 milli	–

6 ⁴ A	16.6 millio	Nearest groups of galaxies (12 million ly)	16.5 milli	–
6 ⁵ B	49.7 millio	Distance to the Virgo cluster (54 million ly)	49.6 milli	Passage of the Sun through the plane of the Milky Way (30–45 million y)
6 ⁶ C	149.0 millio	Local supercluster (110 million ly)	148.9 milli	In-and-out swing of the Sun in the disc (150–170 million y)
6 ⁷ A	446.9 millio	Laniakea (520 million ly); fixed scale in the distribution of galaxies (490 million ly)	446.8 milli	Cycle of the supercontinents (300–500 million y)
6 ⁸ B	1.34 billio	Great Wall of galaxies (1.37 billion ly)	1.34 billio	–
6 ⁹ C	4.02 billio	Largest groups of quasars (4 billion ly)	4.02 billio	Age of Earth and Sun (4.6 billion y)
7 ⁰ A	12.07 billio	Hubble radius (14.4 billion ly)	12.06 billio	Age of the universe (13.8 billion y)
7 ¹ B	36.20 billio	Radius of the observable universe (46.5 billion ly)	36.19 billio	–

Appendix B. Symbols and numbers

Symbol	Meaning	Value
T ₀	natural unit of time	1.521×10^{-16} s
S ₀	natural unit of space	45.6 nm
n	depth, the number of the layer	0 to 306
3 ⁿ	states at depth n	–
$(3^n - 1)/2$	range at depth n	1, 4, 13, 40, 121, 364, ...
g(n)	addresses at depth n	3, 6, 11, 24, 51, 130, ...
T(n)	state of layer n	+1, 0, –1
A, B, C	families n = 1, 2, 0 modulo 3	C = –(A + B)
q	closure depth	1, 2, 5, 12, 41, 53, 306

Annotated references

Konstapel, J. (2026). *The Vacuum.Net Theory: Complete Derivation, from Axioms to the Two Roads of Energy*. Constable Research, Leiden, 28 September 2026. *Why read?* The five axioms, the register, the ladder strand–winding–knot–mesh and the natural units T₀ and S₀ used here. *Reading advice:* Sections 2, 3 and 5.

Konstapel, J. (2026). *The Vacuum.Net Theory: Foundational Paper*, sixth edition. Constable Research, Leiden. *Why read?* Theorem T7, the unique address, with its proof, and the reason for three. *Reading advice:* Part II.

Konstapel, J. (2026). *Closure Without Alignment*. Constable Research, Leiden, 23 September 2026. *Why read?* The closure rule on a window of three trits, the 9 closed triples, and the measure

of closure against a shuffled series. Section 10 here uses that measure. *Reading advice*: Theorems 1 to 4.

Konstapel, J. (2026). *The Current State of the Vacuum.Net Theory*. Constable Research, Leiden, September 2026. Why read? The two ladders, the closure depths on the convergents of $\log_2 3$, and the comma as residue. *Reading advice*: the part on the thread of three.

Larson, D. B. (1959). *The Structure of the Physical Universe*. Portland: North Pacific Publishers. Why read? The natural units from the Rydberg frequency and the speed of light. *Reading advice*: Chapter 13.

Knuth, D. E. (1997). *The Art of Computer Programming*, Vol. 2, §4.1. Reading: Addison-Wesley. Why read? Balanced ternary: uniqueness and range. *Reading advice*: a few pages; the examples are worth doing by hand.

Hardy, G. H., and Wright, E. M. (1938). *An Introduction to the Theory of Numbers*. Oxford: Clarendon Press. Why read? Continued fractions and why their convergents are the best approximations. It is the ground under the closure depths. *Reading advice*: Chapter X.

Fox, R. H. (1970). "Metacyclic invariants of knots and links." *Canadian Journal of Mathematics* 22. Why read? The colouring condition at a crossing that is the closure rule. *Reading advice*: the definitions suffice.

Margot, J.-L., and others (2021). "Spin state and moment of inertia of Venus." *Nature Astronomy* 5, 676–683. Why read? The measured rotation of Venus, 243.0226 days, the sharpest entry of Section 8.

Meeus, J. (1991). *Astronomical Algorithms*. Richmond: Willmann-Bell. Why read? The lunar months, the Saros and the periods of apsides and nodes used in Section 8. *Reading advice*: the chapters on the Moon and on eclipses.

Holme, R., and de Viron, O. (2013). "Characterization and implications of intradecadal variations in length of day." *Nature* 499, 202–204. Why read? The oscillation of 5.9 years in the length of day, read as a signal of the core. *Reading advice*: the figure with the filtered series.

GRAVITY Collaboration (2019). "A geometric distance measurement to the Galactic center black hole with 0.3% uncertainty." *Astronomy & Astrophysics* 625, L10. Why read? The distance to the centre of the Milky Way, 8,178 parsec or 26,670 light years, which places it on layer 58.

Evans, C. D., and others (2021). "Overriding water table control on managed peatland greenhouse gas emissions." *Nature* 593, 548–552. Why read? The measured relation between water table and emission in peat: about 3 tonnes of carbon dioxide per hectare per year for every 10 cm. *Reading advice*: the main figure; it is the human layer in one graph.

SILSO, Royal Observatory of Belgium. *Sunspot Number*, monthly mean total, from 1749. Why read? The series for layer 51 in Measurement 1 and Measurement 3.

NOAA Physical Sciences Laboratory. *Niño 3.4 sea-surface temperature index*, monthly, from 1870. Why read? The series for layer 50 in Measurement 1 and Measurement 3.