

The Speed of Light Is Near Three Hundred Million Because Length Is Decimal and Time Is Sexagesimal

— Perfecting the survey moves c further from three hundred million, and decimal time destroys the nearness —
the separator is whether the digits move when the units are changed — [Paper 1055]

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— *From thinking to syncing.* —

Abstract

The speed of light is **299792458** m/s. This paper asks what is recorded by a figure that falls **207542** short of 3×10^8 . No new theorem and no new law is claimed.

First, and this is the core. What makes it near three hundred million is a mixture of bases: length is divided decimally and time sexagesimally—under the decimal time that France enacted in 1793 (a day of ten hours, a hundred minutes, a hundred seconds) the decimal second is **0.864000** of the present second and the speed of light becomes **2.590207** times ten to the eighth. The relative distance from the mantissa to the nearest integer grows from **0.000691807** to **0.136597721**, worse by a factor of **197.450715** (Section 5).

Second, the Earth does matter, but in the opposite direction—the metre was designed as one ten-millionth of the meridian quadrant. Using the length **10001965.729** m obtained in Paper 915, the speed of light in the metre as designed is **299733538.5**, and the gap from 3×10^8 widens from **207542** to **266461.5**, a factor of **1.283892**. The error of the survey was working towards three hundred million, not away from it (Section 3).

Third, caesium contributes nothing to the figure—**9192631770** was chosen to reproduce a second that already existed. Even if the Earth slowed until a day were 3 milliseconds longer, the speed of light would move by only **10.4** m/s, which is **5.016** times ten to the minus five of the gap (Section 4).

Fourth, being round is not in itself remarkable—of twenty-five constants the mantissa of the speed of light is nearest to an integer, but if mantissas are log-uniform the chance that the roundest of them is this round is **0.119300** (two hundred thousand simulations) or **0.126781** (closed form). It happens one time in eight (Section 6).

Fifth, a rounder number exists, and that one does not move with the units—the inverse fine-structure constant **137.035999177** lies at a relative distance **0.000262768** from 137, rounder than the speed of light by a factor of **2.6328**. Under decimal time the mantissa of the speed of light moves from **2.997925** to **2.590207**, while this dimensionless one does not move. The separator is whether the digits move when the units are changed (Section 7).

Sixth, coincidences come in three grades, and there a reversal occurs—the agreement between g and the square of the circle constant, a fossil of a rejected definition (relative difference **0.006378614**), is worse by a factor of **9.220227** than the mere accident of the speed of light and 3×10^8 (**0.000691807**). Yet only the former has a cause (Section 8).

Keywords: speed of light, systems of units, definition of the metre, convention and fact, dimensionless quantities, multiple comparisons.

Scope of this paper (scope note): No new theorem and no new law is claimed—that the metre was designed from the meridian, that the speed of light has been a defined value since 1983, that the caesium transition frequency has been a defined value since 1967, that France enacted decimal time in 1793, and that the seconds pendulum was a candidate for the metre are all standard facts. The history is not retold—which survey party measured what and when, and how decimal time was administered, are not treated. What is used is only the ratio of a length and a time that can be computed today. No system of units is called better—decimal time is called neither better nor worse. Only that changing the base changes how the digits look. The subtracted number is not claimed to mean anything—the difference 207542 from 3×10^8 carries the dimension of m/s, and the reference 3×10^8 itself depends on the units. This difference cannot be pursued as a physical quantity. The fine-structure constant is not explained—why it is near 137 is not answered. That Eddington took it to be exactly 137, that it is in fact 137.035999177, and that it runs with energy are written only as cautions. The history of measurement is not judged—how accurate the 1975 value was is not asked. Only the order of its uncertainty is compared with the order of the gap. The agreement of g with the square of the circle constant is not called a shared root—what the two share is a fork in history, not one source. It is not a shared root in the sense of Paper 300. Relation to earlier papers: the scope note of Paper 915 said that the definition of the metre would not be discussed, and that the ratio of the meridian quadrant to ten million metres would merely be set down once—this paper takes that seat (no earlier occupant; the gravity item of the same scope note is occupied by Paper 1038). Paper 306 showed that the number of base units is a promise, and its scope note also said that no metrology would be built—here it is counted how that promise survives in the digits of a constant. Paper 314 showed that c is a defined value rather than a measurement—here it is seen in which measurement's digits that defined value froze. Paper 499 showed that not one of the four classical measurements of the speed of light measures one way—that paper is about how it was measured, this one about the digits of what was measured. Paper 1049 counted that the number of unit slots is a rank, and Paper 1054 showed that length and angle depend on the basis—this paper applies that question of what moves to the digits of a constant. Paper 95 separated convention from fact—here, within one and the same number, the digits fall on the side of convention and the ratio on the side of fact. Paper 300 showed that whether two things share a root is decidable—following that discipline, no root is inferred from numerical nearness alone. Paper 117 showed that scale invariance fixes an exponent in four ways—an exponent does not move with the units, but digits do. This paper sets the two in contrast. What is added is showing that perfecting the survey moves c further from 3×10^8 , measuring that decimal time makes the roundness worse by a factor of 197, counting that caesium and the slowing rotation act at five parts in a hundred thousand of the gap, giving the ranking of roundness among twenty-five constants and the chance that it arises by accident, contrasting a dimensionless number that is rounder and does not move with the units, and dividing coincidences into three grades and showing the reversal in which the numerically better one has no cause.

1. The question, and the subtracted number

Setting: the speed of light is 299792458 m/s.It falls **207542.0** m/s short of 3×10^8 , a fraction of **0.000691807**, that is 0.069181 per cent.

Does this shortfall have an identity?The answer first—it does not.The difference 207542 carries the dimension of m/s, and so does the 3×10^8 it is subtracted from.Moreover the sense that 3×10^8 is round stands only on the convention of base ten.What can be pursued is not the difference itself but why it fell on these digits in these units.

2. The Earth: there is a connection

In 1791 the metre was designed as one ten-millionth of the meridian quadrant, from the equator to the pole.That length was computed from the reference ellipsoid by two routes.

Route	Quadrant
Numerical integration	10001965.729 m
Series	10001965.729 m
Difference	0.000000 m

Paper 915 obtained this **10001965.729** m and its ratio to ten million metres—here the same value is applied on the side of the speed of light.Dividing the quadrant by 10^7 gives **1.000196573** m.So the present metre is 0.1966 millimetres shorter than the design.

One control went against expectation: a sphere of the equatorial radius would give a quadrant of 10018754.2 m, longer than the oblate Earth by **16.788** kilometres.Flattening shortens the meridian.

3. Perfecting the survey moves *c* further from three hundred million

Suppose the eighteenth-century survey had been perfect and the metre were exactly one ten-millionth of the quadrant. What would the speed of light be?

Choice of metre	c	Gap from 3×10^8	Fraction
The present metre	299792458.0	207542.0	0.000691807
The metre as designed	299733538.5	266461.5	0.000888205

It moves away. The factor is **1.283892**. So it is not that an old error in surveying left the figure awkward—the error was working towards three hundred million.

Ask the converse. How different would the Earth have to be for the speed of light to be exactly 3×10^8 ? The required metre is **0.999308193** m and the required quadrant 9993081.93 m, differing from the true one by **8.884** kilometres. The actual error of the survey amounts to 1.966 kilometres of quadrant, so an error **4.519338** times larger would be needed. Historically that is out of reach.

4. Caesium: it contributes nothing

The caesium hyperfine frequency 9192631770 Hz has been a defined value since 1967. Dividing the speed of light by it gives **0.032612256** m, a wavelength of about 3.3 centimetres—not round.

And this number was chosen to reproduce a second that already existed. So it did not make the digits of the speed of light. The size of its influence is measured through the slowing of the Earth's rotation.

Excess in a day	c in that second	Shift	Fraction
1 millisecond	299792461.470	3.5 m/s	1.157e-08
3 milliseconds	299792468.409	10.4 m/s	3.472e-08

Even with a day 3 milliseconds longer the shift is **10.4** m/s, which is **5.016** times ten to the minus five of the gap 207542. Four orders short.

5. The core: what acts is the mixture of bases

France enacted decimal time by law in 1793—a day of ten hours, an hour of a hundred minutes, a minute of a hundred seconds. That decimal second is **0.864000** of the present second. Had it survived, the speed of light would be **259020683.7** metres per decimal second, that is **2.590207** $\times 10^8$.

Roundness is measured thus: write a number as a mantissa times a power of ten, and take the relative distance from the mantissa to the nearest integer from 1 to 9.

Choice of units	<i>c</i>	Roundness	Times worse than the present SI
Present SI (decimal length, sexagesimal time)	2.997925e8	0.000691807	1
Decimal time (France, 1793)	2.590207e8	0.136597721	197.450715
Seconds-pendulum metre	3.017170e8	0.005723315	8.273
Seconds-pendulum metre with decimal time	2.606835e8	0.131055056	189.44
Metre with the quadrant at its true value	2.997335e8	0.000888205	1.284

Two rows together give the core: the four variants that change how time is divided or how length is fixed are all at least 8 times less round than the present SI. By contrast, the variant that only improves the survey is worse by a mere factor of **1.284**. Hence what acts is not the shape of the Earth but the division of time.

Put otherwise, the sense of nearness to three hundred million stands only where two separate conventions met: length divided decimally and time divided sexagesimally.

6. How remarkable is a round constant?

For 25 constants the relative distance from the mantissa to the nearest integer was computed and sorted.

Rank	Constant	Mantissa	Relative distance
1	Speed of light	2.997924580	0.000691807
2	Avogadro constant	6.022140760	0.003690127
3	Electron mass	9.109383714	0.012153746
4	Standard atmosphere	1.013250000	0.013250000
5	Vacuum permittivity	8.854187819	0.016201353
6	Caesium frequency	9.192631770	0.021403530

The speed of light ranks first. But is that surprising? Taking mantissas to be log-uniform, the chance that the roundest of 25 is this round was computed——**0.119300** by two hundred thousand simulations and **0.126781** in closed form, the two agreeing to 0.007481.

Hence it happens one time in eight. Look at many constants and one of them will be round——that the speed of light was the one says no more than that.

7. A rounder number exists, and it does not move with the units

The inverse fine-structure constant is 137.035999177, at a relative distance **0.000262768** from 137. That is **2.6328** times rounder than the **0.000691807** of the speed of light and 3×10^8 .

The decisive difference is here: does it move when the units are changed?

Quantity	Present SI	Under decimal time
Speed of light	2.997925e8	2.590207e8 (moves)
Inverse fine-structure constant	137.035999177	137.035999177 (does not)

Hence digits record something only when they do not move with the units. The digits of the speed of light record the history of the units; those of the fine-structure constant record the world.

Being dimensionless, however, does not license an argument from roundness. Eddington took the inverse fine-structure constant to be exactly 137, but it is 137.035999177, a difference of 0.035999. Moreover the quantity runs with energy and takes a different value at high energies. This paper does not answer why it is near 137.

8. Three grades of coincidence, and a reversal

One question separates them: if the historical decision were changed, would the coincidence move?

Grade	Example	Relative difference
(A) A definition itself	Permeability and 4π times ten to the minus seven	1.320e-10
(B) A fossil of a rejected definition	<i>g</i> and the square of the circle constant	0.006378614
(C) A mere accident	The speed of light and 3 times ten to the eighth	0.000691807

Here a reversal occurs——(B) is worse numerically by a factor of **9.220227**, and yet it is (B) that has a cause.

The reason lies in history. There were two candidates for the metre: the meridian, and the length of the seconds pendulum (one whose full swing takes two seconds). That length is **0.993621386** m. Had it been chosen in 1791, the acceleration of gravity would be exactly the square of the circle constant in that unit——the check gives **9.869604401089**, differing from the square of the circle constant by 0. The present near equality is the shadow left by a definition that was not adopted.

(C) has nothing of the kind. In none of the five choices of Section 5 does the speed of light become exactly round.

9. The day the digits froze

In 1983 the causal arrow reversed.

Period	Relation
Before 1983	The speed of light was measured in metres
After 1983	The metre is fixed by the speed of light

The metre is now the distance light travels in $1/299792458$ of a second. So the digits of the speed of light are frozen at the digits of the 1975 measurement. Even taking the relative uncertainty of that value as 10^{-8} , the gap from 3×10^8 is **6.923** times ten to the fourth larger——the gap cannot be explained by the scatter of the measurement.

10. Census and closing

Closing: the speed of light is near three hundred million because length is decimal and time is sexagesimal. Under the decimal time of France in 1793 the speed of light becomes **2.590207** times ten to the eighth and the roundness worsens from **0.000691807** to **0.136597721**, a factor of **197.450715**——whereas improving the survey moves it by a factor of only **1.284**. The Earth matters, but in the opposite direction——with the quadrant **10001965.729** m obtained in Paper 915, the speed of light in the metre as designed is **299733538.5** and the gap widens by a factor of **1.283892**. To make it exactly three hundred million the quadrant would have to differ by **8.884** kilometres, **4.519338** times the actual error of the survey. Caesium contributes nothing to the figure——even with a day 3 milliseconds longer the speed of light moves by only **10.4** m/s, **5.016** times ten to the minus five of the gap. Being round is not in itself remarkable——the speed of light ranks first among 25 constants, but the chance of that by accident is **0.119300**. A rounder number exists and does not move with the units——the inverse fine-structure constant lies **0.000262768** from 137, rounder by a factor of **2.6328**, and its mantissa does not move under decimal

time. And the three grades of coincidence show a reversal—the agreement of g with the square of the circle constant (**0.006378614**) is worse by a factor of **9.220227** than that of the speed of light with three hundred million (**0.000691807**), yet it holds exactly in the seconds-pendulum metre of **0.993621386** m. The cause belongs to the worse one. The separator is whether the digits move when the units are changed—if they move they record the history of the units, and if not they record the world. Plainly—the subtracted number 207542 has no identity (it is a difference carrying the dimension of m/s), and this paper does not answer why the fine-structure constant is near 137. What is added—showing that perfecting the survey moves the speed of light away from three hundred million, measuring that decimal time worsens the roundness by a factor of 197, counting that caesium and the slowing rotation act at five parts in a hundred thousand, giving the ranking of roundness and the chance of it arising by accident, contrasting a dimensionless number that is rounder and immobile, and dividing coincidences into three grades to show that the numerically better one has no cause.

Revision Record

2nd edition (September 2026): The fine-structure constant, the electron mass and the permittivity and permeability of the vacuum were changed from the CODATA 2018 recommended values to the CODATA 2022 recommended values (the inverse of the fine-structure constant from **137.035999084** to **137.035999177**). Only the last digits changed: the relative distance of the inverse fine-structure constant from **137** went from **0.000262767** to **0.000262768**, and in the table of **25** constants the last digit of the electron mass and of the vacuum permittivity moved, with the ranking unchanged. In the table of the three grades of agreement, the relative difference in row (A) went from 5.444×10^{-10} to 1.320×10^{-10} (with the present recommended value the permeability cannot be told apart from $4\pi \times 10^{-7}$ within the measurement uncertainty). The numbers concerning the speed of light and the conclusions of this paper are unchanged.

References

1. Bureau International des Poids et Mesures (2019). *The International System of Units (SI)*. BIPM.
2. Eddington, A. S. (1946). *Fundamental Theory*. Cambridge University Press.
3. National Institute of Standards and Technology (2019). *CODATA Recommended Values of the Fundamental Physical Constants: 2018*. NIST.
4. National Institute of Standards and Technology (2024). *CODATA Recommended Values of the Fundamental Physical Constants: 2022*. NIST.
5. Yamagishi, Y. (2026). *Convention and Fact* [Paper 95]. Zenodo. 10.5281/zenodo.21758621
6. Yamagishi, Y. (2026). *Scale Invariance Fixes an Exponent* [Paper 117]. Zenodo. 10.5281/zenodo.22005515
7. Yamagishi, Y. (2026). *The Three Hundredth Census: Whether Two Things Share a Root Is Decidable* [Paper 300]. Zenodo. 10.5281/zenodo.22171914

8. Yamagishi, Y. (2026). *How Many “Base” Units There Are Is a Promise* [Paper 306]. Zenodo. 10.5281/zenodo.22172149
9. Yamagishi, Y. (2026). *There Is Only One Kind of Constant You Can Ask “Has It Changed?” About* [Paper 314]. Zenodo. 10.5281/zenodo.22175192
10. Yamagishi, Y. (2026). *Not One of the Four Classical Measurements of the Speed of Light Measures One Way* [Paper 499]. Zenodo. 10.5281/zenodo.22760231
11. Yamagishi, Y. (2026). *A Degree of Latitude Is Longer Near the Pole, and Flattening Read from Two Arcs Magnifies Their Error Over a Hundredfold* [Paper 915]. Zenodo. 10.5281/zenodo.22922428
12. Yamagishi, Y. (2026). *The Geoid Is the Surface on Which Clocks Run at the Same Rate* [Paper 1038]. Zenodo. 10.5281/zenodo.22860780
13. Yamagishi, Y. (2026). *There Are Three Unit Slots Because Mechanics Uses Only Three Kinds of Quantity* [Paper 1049]. Zenodo. 10.5281/zenodo.22902445
14. Yamagishi, Y. (2026). *Three Independent Quantities Do Not Always Make a Set of Base Units* [Paper 1054]. Zenodo. 10.5281/zenodo.22904783

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