THE DRAWING IS A PHYSICS EQUATION · A PLAIN-LANGUAGE GUIDE TO THE J.C. DRAWING AT SOUNDLIGHTFREQUENCY.COM

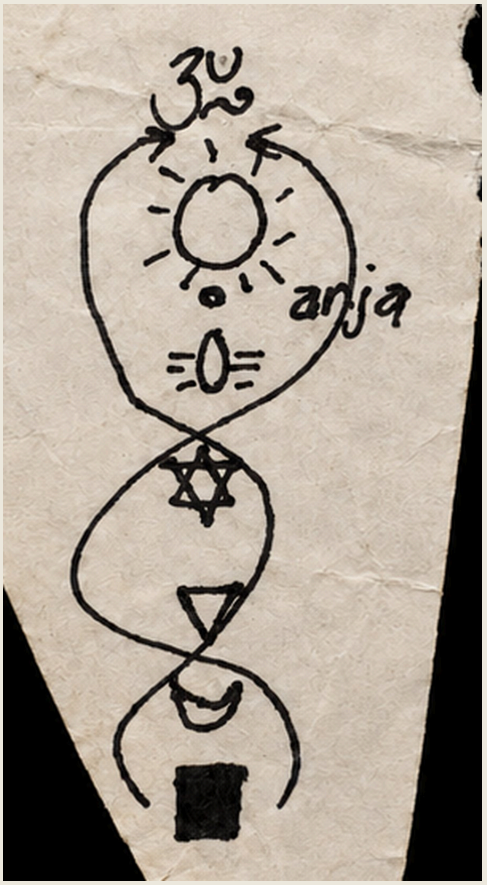
Sound × Light × Frequency = 1/137

The drawing is a physics equation.

Put in one measured number and it gives the fine-structure constant to eleven digits, and Newton's gravitational constant too.

137.035999164	137.035999165
what the drawing gives, from one input	what the best measurement says, ±16

In 1996, at the premiere party for *Dark Skies*, a man who called himself J.C. took about thirty seconds to draw this on the back of a bank envelope. He said it showed the secrets of the universe, and he described them as sound, light and frequency. Read from the bottom up, its ten marks are the ten steps of a calculation, and his three words are its three parts.



Sound	Frequency	Light
THE BOTTOM	THE MIDDLE	THE TOP

Grant McCracken · October 2026 · written with AI assistance (Claude)

$$1/\alpha = (10/\pi) \times \sqrt{(1836.15)} \div \cos(5.5357°) = 137.036$$

$\alpha = (\pi/4) \cdot P \cdot \cos\sqrt{P}$ $\quad P = (2/5) \cdot \sqrt{q} \cdot (1 + (4/5)\rho^2)$ $\quad q = m_e/m_p$ $\quad \rho = (2/\pi)\, q$

The only input is the proton-to-electron mass ratio, and nothing is fitted. Read as energy, the same step gives $G = 6.674282 \times 10^{-11}$.

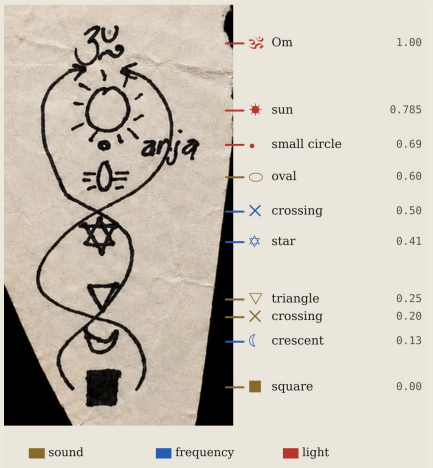
START HERE

The drawing in one minute

Read the drawing from the bottom up, like a recipe, where each mark is one step. The square at the bottom is the one ingredient you put in, the fact that a proton weighs 1836.15 times as much as an electron. Om at the top is what comes out, 1/137.035999164. That is the fine-structure constant, the number that sets how hard light grips matter, which in turn sets how big atoms are and what color everything is. The best measurement ever made says 137.035999165, give or take 16 in the last two digits, so the drawing is right to eleven digits.

J.C.'s three words turn out to be the three parts of the answer.

SOUND	×	LIGHT	×	FREQUENCY	=	α
2/5		π/4 · cos 5.54°		1/42.85		1/137.036
of a hot gas's energy travels away as sound		the share of a wave an observer catches		the proton's natural swing rate over the electron's		how hard light grips matter



Each mark at its height on the paper, colored by its word: gold for sound, blue for frequency, red for light.



10 **Om: the answer.** The two arrows merge into one number, 1/137.036, which is how hard light grips matter.



9 **The sun: the observer.** It catches π/4 of what is there, the same share a round pizza covers of its box.



8 **The small circle: the still point.** It is the still line the two waves lean away from, and J.C. wrote *anja* beside it, the yoga name for where the two side channels meet.



7 **The oval: the sound.** Two-fifths of the energy in a hot gas's jiggling travels away as sound.



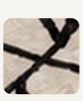
6 **Second crossing: the midpoint.** Its number is 1/42.85, halfway between the electron and the proton when you count by multiplying.



5 **The star: the tilt.** Each wave leans 5.54° off the center line, one to each side.



4 **The triangle: the line you read along.** Measuring means picking a line to look along, and that sets a fifth of the proton aside.



3 **First crossing: keep four-fifths.** Along any one line a ball's spread is a fifth of the whole, so four-fifths are kept.



2 **The crescent: the proton's size.** Its number is 0.000347, the proton's radius measured in the electron's own unit of length.



1 **The square: the proton.** It weighs as much as 1836.15 electrons, and that is the only number you put in.

Nothing in it was adjusted to fit. People have been trying to write 1/137 as a formula for more than a hundred years, and every earlier attempt was either a coincidence with no physics behind it or had a number nudged to make it work. This guide climbs the drawing

one word at a time, sound at the bottom, frequency in the middle and light at the top, and each part starts with the bits of physics you need for it, explained from scratch. Then it puts the equation together, shows what else the same equation gets right, and asks what the observer at the top of the drawing might be.

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Sound times light times frequency, written out, checked, and honest about its assumptions.

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The top three marks as the act of taking a reading. Everything here is speculation, and it is labeled that way.

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The Great Pyramid and the plateau, sound under the ground, frequency at the surface and light above.

8 The paper, the people this is built on, and two reference pages 44

The preprint, the credits, every number at a glance, and the words used in this guide.

PART 1 · SOUND · THE BOTTOM OF THE DRAWING

Sound: the heavy proton and the 2/5

Sound is a push passed along from one bit of stuff to the next, and in a gas of protons and electrons it is the heavy protons that carry it. The sound marks are the square, the first crossing, the triangle and the oval, and they give the equation its one input and its two fractions, 4/5 and 2/5.



1.1 WHAT YOU NEED FIRST

Atoms, heat and sound

An atom, and the one number

Everything you can touch is made of atoms, and the simplest atom of all is hydrogen. A hydrogen atom has one proton in the middle and one electron around it. The proton carries a positive electric charge and the electron carries a negative one, the same size but opposite, and opposite charges pull on each other, which is why the two stay together. Hydrogen makes up about three-quarters of all the ordinary matter in the universe, so a proton and an electron together are most of what is out there.

The two particles are very different in weight. A proton is 1836.15 times heavier than an electron. That number is a ratio, one weight divided by the other, so it comes out the same whether you weigh them in grams, in pounds or in anything else. Physicists call it the proton-to-electron mass ratio, and it is the only number the drawing's equation needs.

> WORKED EXAMPLE If an electron weighed as much as a paperclip, about one gram, a proton would weigh 1836 grams, which is about as heavy as a four-pound bag of sugar.

Heat is jiggling, and it gets shared out evenly

Temperature measures jiggling. The atoms in anything warm are bouncing around, and the hotter it is, the faster they go. When lots of particles keep bumping into each other, their energy gets shared out evenly among all the different ways they can move. A single particle can move in three directions, left and right, forward and back, and up and down, and on average each direction ends up with the same share of the energy. Physicists call this equipartition, and it is one of the most dependable rules in physics.

WORKED EXAMPLE Think of a pizza split evenly at a party, where every way of moving gets the same size slice. If a gas's motion comes in five kinds, each kind gets one-fifth. If two of the five can leave the room and three can't, two-fifths of the pizza leaves.

Sound is a push, passed along

Clap your hands and you shove the air next to them. That air shoves the air next to it, and the push travels all the way to someone's ear while the air itself mostly stays where it was. That is sound. It wiggles back and forth along the direction it travels, the way a pulse runs down a Slinky when you push on one end, and it needs stuff to travel through, which is why there is no sound in empty space. The heavier the stuff it has to push, the more slowly it goes.

Plasma, hydrogen taken apart

Heat hydrogen to many thousands of degrees and its atoms crash into each other hard enough to knock the electrons loose. What you get is a soup of loose protons and loose electrons, called a plasma. The sun is a giant ball of it, a lightning bolt is plasma, the glow inside a neon sign is plasma, and so is most of the visible universe. In a plasma the protons carry the sound, because they carry almost all of the weight, and weight is what a push has to move.



1.2 The square height 0.00 SOUND

The square is the ground floor. It stands for the proton, the heavy one of the pair, and every other mark is built on top of it. It is also the only number you put in.

THE NUMBER 1836.15. A proton weighs as much as 1836.15 electrons.

HOW YOU GET IT Nobody calculates this number. It is measured by weighing the two particles against each other in a magnetic trap, to eleven digits. It also compares two completely different ways of being heavy. The electron gets its mass from the Higgs field, while the proton gets almost all of its mass from the energy of the strong force holding its three quarks together.

WHY SOUND In a hot gas of protons and electrons, the protons carry the sound because they hold nearly all the weight, so the proton's mass sets how fast sound travels.

IT IS ALSO A FREQUENCY Every particle ticks like a clock at a rate set by its mass (2.1), so 1836.15 is also how many times faster the proton's clock ticks than the electron's.

IN THE YOGA MAP Muladhara, the root chakra at the base of the spine, is drawn as a yellow square inside four red petals, the sign for earth. J.C. filled his square in solid, which makes it the heaviest-looking mark on the paper.

IN THE PAPER Section 3.1.



1.3 The first crossing `height 0.198` SOUND

The two waves cross one-fifth of the way up the paper, and one-fifth is this mark's number. Take a solid ball and measure how its stuff is spread out along one line through the middle. That line accounts for exactly one-fifth of it, measured against the ball's edge, so any reading taken along one line sets a fifth aside and keeps the other four-fifths. The five kinds of motion in a hot gas give the same split, since four of them carry a push and one, a patch a little hotter or cooler than its neighbors, carries none (1.5).

> THE NUMBER 1/5, which leaves 4/5.
>
> FEEL IT A solid ball is easier to spin up than a flat coin of the same weight and width, and it takes exactly 4/5 of the coin's effort. That is the same 4/5.
>
> WHY SOUND Sound is pushing, and the 4/5 that gets kept is the share that pushes. Since 2018 Jefferson Lab has been measuring the push inside the proton itself, and any ball that holds itself together obeys the same 4/5 between its pressure and its shear. That part is a proven theorem about stable balls, so nobody had to fit it to anything.
>
> ON THE PAPER The crossing is measured at 0.198 of the height. One-fifth is 0.200.
>
> IN THE YOGA MAP This one is not a chakra. The yoga books draw two channels winding up the spine, ida on the left, cool like the moon, and pingala on the right, hot like the sun, and they cross between the chakras. On the drawing they are the two waves, and this is where they cross first. Read that way, ida would be the slow sound wave and pingala the fast light wave (2.2).
>
> IN THE PAPER Section 3.3.



1.4 The triangle `height 0.25` SOUND

To measure anything, you have to look along some line, and the triangle is that choice. It points straight down the center line, just above the crossing where the fifth gets lost, which fits, since picking a direction is the reason the fifth gets lost.

> THE NUMBER It has none of its own. It is the step that produces the 4/5 at the crossing below it.
>
> WHY SOUND Sound always travels along a line, and a push always has a direction. In the paper this is also the line the last step turns around. The two arrows at the top lean away from it, one to each side, and because everything turns around it, it is the one line that stays put.
>
> IN THE YOGA MAP Manipura, the solar plexus chakra above the navel, is a red triangle pointing down, the sign for fire. It sits in the gut, where a lot of decisions get made, so a triangle that stands for making a choice fits it well.
>
> IN THE PAPER Section 3.4.

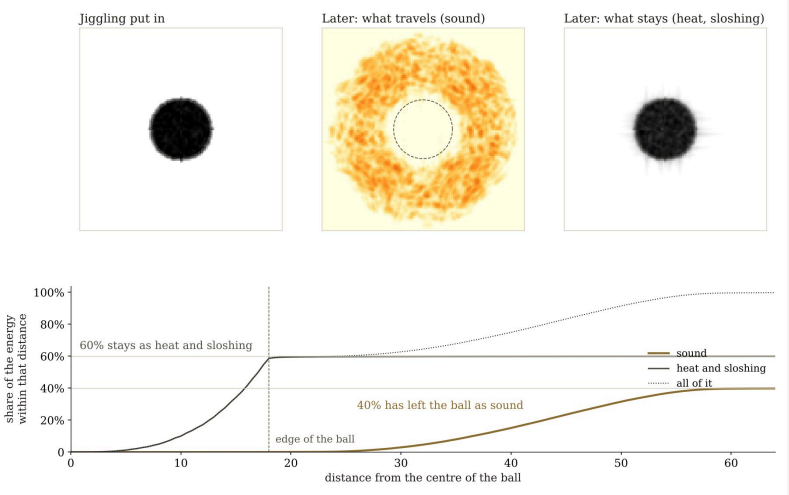


1.5 The oval with six rays `height 0.60` SOUND

The oval stands for the plasma and the sound it carries, and its number, 2/5, is the biggest fraction in the equation. In a gas, the slow, large-scale part of the jiggling comes in exactly five kinds. Two of them are sound, a pressure wave heading one way and a pressure wave heading the other. One is a patch that is a little hotter or cooler than its neighbors. The last two are sideways sloshing, where one layer of gas slides past the next. Each of the five gets the same share of the energy, and only the two sound waves travel. The hot patch and the sloshing stay where they are and slowly smear out. So two-fifths of the energy leaves as sound and three-fifths stays put.

The same goes for what the gas can tell anyone about itself. A listener far away hears only the sound, so it can learn two-fifths of what the gas holds about its own temperature and never gets the rest. The gas is only the easiest place to see the count. The equation doesn't need a real gas around the proton. The paper makes the same count over the proton's and the electron's own ways of moving, five apiece, and the electric field grips two of each five, which is two-fifths again.

> `THE NUMBER` 2/5, the share of the plasma's heat energy that travels away as sound.
>
> `THE SIX RAYS` A single particle can move in three directions, and along each one it can go forward or back, which makes six.
>
> `IN THE YOGA MAP` Vishuddha, the throat chakra, is a full moon inside sixteen blue petals. The throat is where the body makes its sounds, so it suits the one mark on the paper that stands for sound.
>
> `IN THE PAPER` Section 3.7.



The 2/5, run on a computer. A ball of gas starts out jiggling at one temperature inside still gas, and the ordinary equations of sound are run. By the time the sound has crossed the ball, 40.0% of the energy has left as sound, which is the ring, and 60.0% is still inside the dashed circle as heat and sloshing. The total energy stays the same to fifteen decimal places.

That holds for any gas, whatever it is made of, as long as space has three directions. A flat world would give 2/4, which is one more reason not to live in one. For a gas of single particles, which is what loose protons and electrons are, the same 2/5 also falls out of how springy the gas is. Squeeze it and it pushes back with a stiffness of 5/3, and (5/3 − 1) ÷ 5/3 = 2/5. The two wavy lines of the drawing give a third road to the same number, since of the ten ways a gas of protons and electrons can move at each wavelength, the two waves take up four (2.2).

All of this is for a plain plasma, with no magnetic field running through it and one temperature for its protons and electrons. A magnetic field or two different temperatures would change the share, and the answer would no longer come anywhere near α.

PART 2 · FREQUENCY · THE MIDDLE OF THE DRAWING

Frequency: the two waves and the midpoint

Frequency is timing, meaning how fast something swings and whether two swings are in step. The frequency marks are the crescent, the star and the second crossing, and they give the equation its middle: the proton's size, a small difference in timing between the two waves, and the 42.85 between the proton and the electron.



2.1 WHAT YOU NEED FIRST

Waves, timing and counting by multiplying

How far apart, and how often

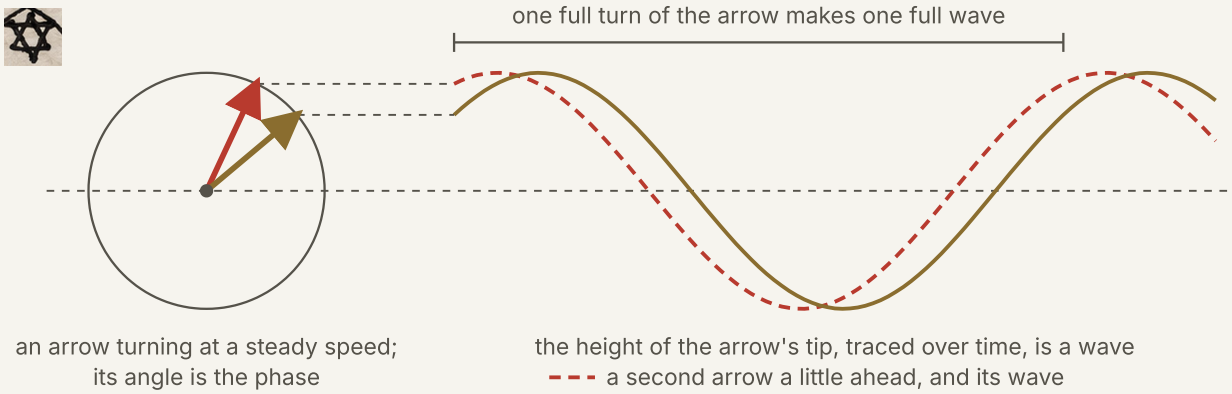
A wave is a disturbance that travels while the stuff it travels through mostly stays put. When a crowd at a ballgame does the wave, each person just stands up and sits back down, but the wave goes all the way around the stadium. Two numbers describe a steady wave. The wavelength is the distance from one crest to the next, and the frequency is how many crests go past each second, measured in hertz, which simply means "per second." Multiply the two together and you get how fast the wave travels.

> WORKED EXAMPLE Ocean waves with their crests 50 meters apart, rolling past the end of a pier once every 10 seconds, have a frequency of 0.1 hertz, and they travel at 50 × 0.1 = 5 meters a second.

Waves come in two kinds, depending on which way they wiggle. A push wave wiggles back and forth along the direction it travels, like the Slinky, and sound is that kind. A side-to-side wave shakes across the direction it travels, like a rope you flick up and down, and light is that kind.

A wave is a turning arrow, and its timing is called phase

Pin an arrow at the center of a circle and spin it at a steady speed, the way the hand of a clock goes around, only faster. Now watch only how high the arrow's tip is. As it goes around, the tip rises, falls, dips below the center and comes back up, and if you plot that height over time, you get a smooth wave, with one full turn of the arrow making one full wave. Which way the arrow points at a given moment is called the phase. Two waves with the same frequency are like two arrows turning at the same speed. If they point the same way, the waves are in step. If one arrow is a few degrees ahead of the other, the waves are a little out of step, and that small difference in timing shows up as a small angle between the two arrows.



A wave is the height of a turning arrow, traced over time. The gold arrow makes the solid wave. The red arrow turns at the same speed but is a little ahead in its turn, so its wave, the dashed one, runs a little ahead too. On the drawing, the angle between the two arrows is the star's tilt.

WORKED EXAMPLE Two speakers playing the same note in step make it louder. Shift one of them by half a turn, 180°, and the crests from one land on the troughs from the other, so the two cancel out, which is how noise-canceling headphones work. A shift of only 5.54° barely changes anything, and 3.1 works out exactly how little. Physicists often measure these angles in radians instead of degrees. A full turn is 2π radians, about 6.283, so one radian is about 57.3°, and 5.54° is 0.0966 radians.

Counting by multiplying

The usual halfway point between two numbers is their average, so halfway between 1 and 100 is 50.5. There is another kind of halfway, where you count by multiplying instead of adding. Going from 1 to 100 by multiplying takes two equal steps of ×10, from 1 to 10 and then from 10 to 100, so the multiplying halfway point is 10. You find it by multiplying the two ends together and taking the square root, √(1 × 100) = 10. Your ears already count this way. Every octave up on a piano doubles the frequency, and the ear hears each doubling as the same-size step.



Two ways to find a halfway point. Counting by adding, halfway between 1 and 100 is 50.5. Counting by multiplying, it is 10, because two steps of ×10 take you from 1 to 100. The second crossing is the multiplying halfway point between the electron and the proton, since two steps of ×42.85 take you from 1 to 1836.15.

Steps, clocks, and the jiggle that never stops

At the size of atoms, energy doesn't come in any amount you like. It comes in steps, more like a staircase than a ramp, and a faster swing means bigger steps. Max Planck found that rule in 1900. The bottom step isn't at zero, either. Even the stillest possible state keeps half a step of jiggle that can never be taken away, which physicists call zero-point motion, and it is the reason nothing in nature ever sits perfectly still.

Every particle also carries a clock of its own. Einstein's $E = mc^2$ turns a particle's mass into an amount of energy, and Planck's rule turns that energy into a frequency, so every particle ticks at a rate set by its mass, and the proton's clock ticks 1836.15 times faster than the electron's. Each particle also has a natural length that goes with its clock, called its wavelength, which is how far light travels during one tick. The heavier the particle, the shorter its wavelength.

2.2 THE TWO WAVES

The two wavy lines: a light wave and a sound wave

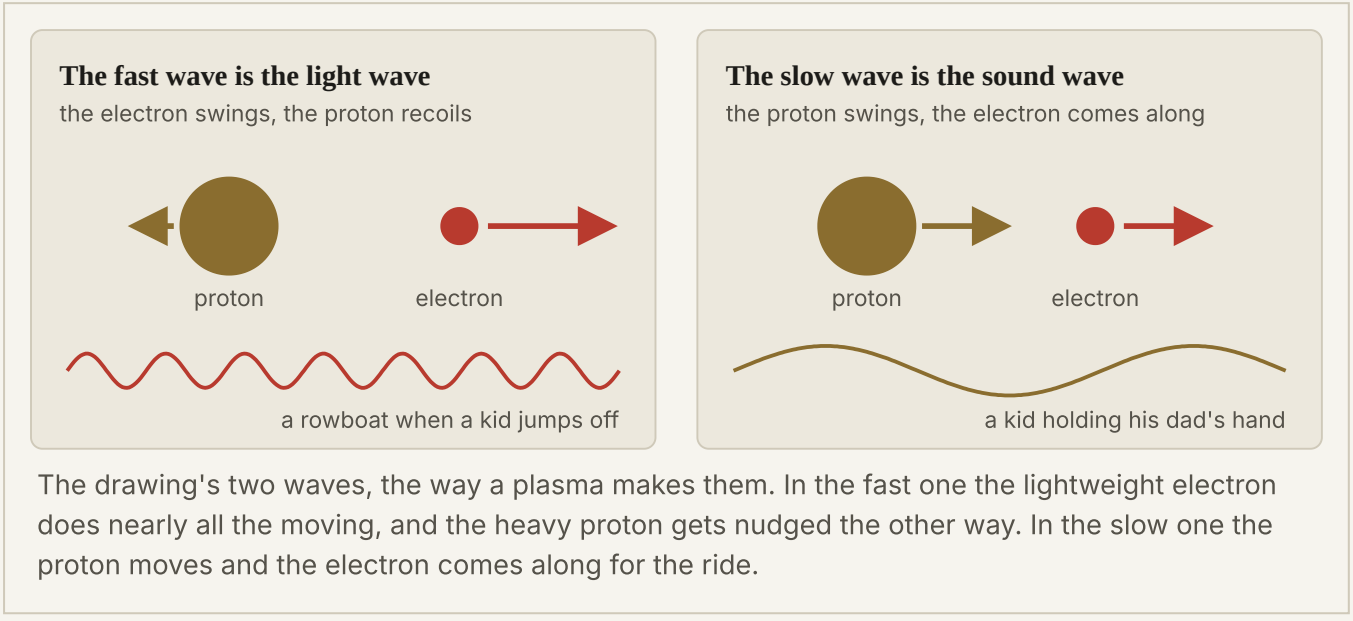
The first thing anyone notices on the drawing is the pair of wavy lines. They start on either side of the square, wind up the page around a straight center line, cross each other twice on the way up, and finish at the top as two arrows aimed at Om. One of them is a light wave and the other is a sound wave, and here is where they come from.

Every particle in a plasma feels the same electric field, set by all the charges together, and that shared field is the straight line the two waves wind around. A plasma can swing. Push the electrons in one spot a little to the side and the field pulls them back. They overshoot, get pulled back again and keep swinging, and that swinging travels through the plasma as a wave. Because there is only one field, a plasma can swing in exactly two ways over long distances, and each way is one of the drawing's two waves.

In the fast wave, the lightweight electrons do the swinging and the heavy protons get shoved a little the other way, while the field keeps pulling the two back toward balance. When a kid jumps off a rowboat, the kid goes one way and the boat scoots a little the other way. Here the electron is the kid and the proton is the boat. Strictly speaking this isn't a beam of light, because light wiggles sideways to its path and this wave wiggles along it, but it is the same electric field doing the wiggling, and it swings at exactly the rate where light inside a plasma begins. Below that rate light can't get through a plasma at all, which is why the charged upper atmosphere bounces AM radio back down to the ground at night. So this wave marks the lowest rate light can have inside a plasma, and that makes it the light side of the drawing.

In the slow wave, the protons do the swinging and the electrons come right along with them, like a kid holding his dad's hand in a crowd, who goes wherever his dad goes. Nothing gets pulled apart, so the field has nothing to pull back together, and the gas's own pressure carries the wave instead. This is the sound of the plasma, and it is the sound side of the drawing.

J.C.'s third word is what tells the two apart. If you took a single snapshot of the plasma, you couldn't say which wave was which, because at any one instant the rowboat's shove and the hand-holding add up to nothing you can see. The only difference between them is how fast they swing, so sound and light alone can't describe the drawing, and you need frequency too.



The drawing's two waves, the way a plasma makes them. In the fast one the lightweight electron does nearly all the moving, and the heavy proton gets nudged the other way. In the slow one the proton moves and the electron comes along for the ride.

How tightly the two waves hold on

Each wave leans a little off the particles' own directions, by the same small angle, 1.34°, and the slope of that lean is 1/42.85, the square root of the electron's mass over the proton's. Physicists call it the kinematic angle, and it is easier to picture than it sounds. Think of a couple out on a dance floor. You can keep track of them one at a time, where he is and where she is. Or you can keep track of where the couple is on the floor, plus how far

apart the two of them are. Both ways hold the same information, and switching from the first to the second is, on paper, a turn by an angle. How big that angle is depends only on how heavy the two dancers are, and for a proton and an electron it comes out at 1.34°.

In both waves the electrons and the protons hold onto each other with a grip of 1 part in 42.85, and the two waves between them carry two-fifths of the plasma's heat energy. Averaged over the whole plasma, the grip comes to 2/5 times 1/42.85, which is the number the equation calls P.

One more detail matters for getting the right answer. The grip has to be measured with nothing moving around inside the plasma. Think of the plasma as a bus full of passengers. The bus can be doing ninety down the highway and the reading comes out the same, but if the passengers start jumping on the seats, it drifts. Even the faint warmth of outer space, 2.7 degrees above absolute zero, would throw the answer off by five error bars, so the paper doesn't use a temperature at all. It counts each kind of motion by the little jiggle that is left over even when something is as still as it can possibly be (2.1).

> ON THE DRAWING The two wavy lines are the two waves, one sound and one light, the straight line they wind around is the one field they share, and they start at `■ the square · 0.00`, the proton.
>
> CREDIT The plasma picture was prompted by the public notes of an engineer who writes as @TMBSPACESHIPS. The angle is the standard kinematic rotation of few-body physics.
>
> IN THE PAPER Section 3.8, the two waves of one field.



2.3 The crescent `height 0.13` FREQUENCY

The crescent is the proton's edge. The proton isn't a dot, and its size goes into the equation as a small correction. The size is counted with the electron's own ruler, its wavelength, which is how far light travels during one tick of the electron's clock (2.1). Measured that way, the proton's radius is 0.000347.

> WORKED EXAMPLE The electron's wavelength is about 2.43 trillionths of a meter, and the proton's radius is about 0.84 millionths of a billionth of a meter. Divide the radius by the wavelength and you get 0.000347.
>
> HOW YOU GET IT In 2019 Ole Trinhammer and Henrik Bohr published a rule that gets the proton's size from its weight alone: π times the proton's radius equals twice the proton's own wavelength. Dividing that radius by the electron's wavelength gives 2/π × 1/1836.15 = 0.000347. Their rule comes out of Trinhammer's model of the proton, in which its insides move in a space of their own and the radius is the yardstick that carries that inner space over into ours. The crescent's correction to the final answer is one part in ten million, but leave it out and the answer is wrong by 846 error bars. Run backward, this is the mark that gives the size of the proton (5.1).

PICTURE IT This picture is the guide's, not Trinhammer and Bohr's. A circle drawn at that radius is exactly four of the proton's wavelengths around. A wave running around a ring has to arrive back where it started in step with itself or it cancels itself out, so a ring only holds whole numbers of waves, the way a loop of toy train track only closes if it's a whole number of pieces long.

WHY FREQUENCY The ruler is the electron's clock. While light crosses from the proton's center to its rim, the electron's clock gets through 0.000347 of one tick. The tick that works is the electron's full tick, the internal clock Louis de Broglie proposed in 1924. Half a tick doesn't work, and neither does the shorter length physicists usually quote, because both of those miss the measured α by thousands of error bars.

WHY A CRESCENT A crescent is the edge of something, and what matters to the equation is the proton's surface, the face where it meets everything else. That face is also where the last step of the equation gets recorded (3.5).

IN THE YOGA MAP Svadhisthana, the sacral chakra below the navel, is a white crescent moon inside six orange petals, the sign for water, lying on its back the same way J.C. drew his.

IN THE PAPER Section 3.2.



2.4 The six-pointed star height 0.41 FREQUENCY

The star is two triangles locked into one shape, one pointing up and one pointing down, and here they stand for the heavy proton and the light electron moving together. The tilt between the two waves comes from this mark. The two waves are like two arrows turning together but leaning 5.54° apart in opposite directions, one a hair ahead and one a hair behind (2.1).

THE NUMBER 5.54°, which is how far each wave tilts away from the center line, one each way.

HOW YOU GET IT Multiply the pieces below the sun together (2/5, times 1/42.85, times the crescent's correction) and you get 0.00933. The tilt is the square root of that, 0.0966 radians, which is 5.54°. There is an older road to the same number. In 1927 Max Born and Robert Oppenheimer worked out why electrons follow heavy nuclei almost perfectly, and the size of that "almost" is the fourth root of the mass ratio, meaning the square root of its square root, 0.153. Put the square root of 2/5 in front of it and you get 5.54° again.

PICTURE IT A crowd claps along at a concert, with half the hands landing a hair early and the other half a hair late. That little bit of timing is what physicists call a phase.

INSIDE A REAL ATOM Hydrogen's second shell holds a pair of little arrows, and one sharp push turns them 5.54° in opposite directions (3.5), so the star's tilt is something a real atom does.

IN THE YOGA MAP Anahata, the heart chakra, is a six-pointed star inside twelve green petals, the sign for air, made of one triangle pointing up and one pointing down.

> IN THE PAPER Section 3.5.



2.5 The second crossing `height 0.499` FREQUENCY

The second crossing sits halfway up the paper, and its number is the halfway point between the electron and the proton, counted by multiplying (2.1). Between an electron at 1 and a proton at 1836.15, the multiplying halfway point is the square root, 42.85, since 42.85 × 42.85 = 1836.15. So 42.85 is 42.85 times the electron and 1/42.85 of the proton.

> THE NUMBER 1/42.85.
>
> IT IS ALSO A REAL RATE In a plasma each kind of particle swings at its own natural rate when it is pushed aside, and the protons' rate divided by the electrons' rate is 1/42.85, the same way a heavy weight on a spring bobs more slowly than a light one. A weight 1836 times heavier bobs √1836 = 42.85 times slower. Both kinds feel the same field, and when two things share one field, the grip between them comes out at the midpoint of the grip each one feels by itself. Fusion labs heat their plasmas at a version of this same midpoint and call it the lower hybrid frequency.
>
> IT IS ALSO AN ANGLE The slope of each wave's lean off the particles' own directions is 1/42.85 (2.2).
>
> ON THE PAPER The crossing is measured at 0.499 of the height. One half is 0.500.
>
> IN THE YOGA MAP The two side channels cross again here, halfway up, between the heart and the throat.
>
> IN THE PAPER Section 3.6.

PART 3 · LIGHT · THE TOP OF THE DRAWING

Light: the observer at the top

Light is the output. The light marks are the small circle, the sun and Om, and the paper calls them the observer, because together they are the act of taking a reading. They turn two waves into the one number we measure, and the last of them happens for real inside a hydrogen atom.



3.1 WHAT YOU NEED FIRST

Light, observers, circles and shadows

Light is a side-to-side wave

Light is a wave in the electric field, and it wiggles sideways to the direction it travels, like a rope you flick up and down. Since there are two sideways directions, up-and-down and left-and-right, light can wiggle in two separate ways, and polarized sunglasses work by blocking one of them. Radio, microwaves, visible light and X-rays are all the same thing at different frequencies, and the color of visible light is its frequency. The fine-structure constant, α, measures how hard light grabs onto charged matter. That grip sets how big atoms are, what colors they glow and how chemistry works, and nobody has ever been able to say why its value is 1/137.

What an observer is

In physics, an observer is anything that takes a measurement. It can be a person, and it can just as well be a thermometer, a camera, a radio telescope or a single atom soaking up a bit of light. Every measurement keeps some information about the thing it measures and loses the rest. A thermometer tells you how hard the air is jiggling on average, but not which molecule went where. A photograph records how bright each spot is and throws away the timing of the light that made it, the phase from 2.1. A hologram keeps the timing as well, and that extra information is why a hologram shows depth when you tilt it.

> WORKED EXAMPLE Tilt the little hologram on a credit card and the picture shifts as if it had depth. Take a flat photo of that same hologram and the photo stays flat, because the photo kept the brightness and lost the timing.

π, and a circle inside a square

Measure the distance around any circle, divide it by the distance across, and you always get the same number, 3.14159 and on forever, which is called π. Now draw a circle that just fits inside a square. If the circle's radius is r, the square is 2r on a side, so its area is 4 × r ×

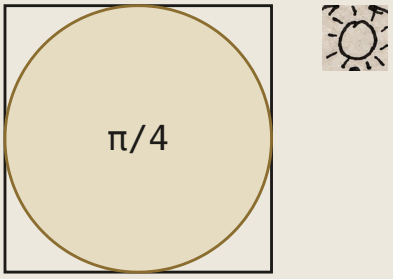
r, and the circle's area is π × r × r. Divide the circle by the square and the r's cancel, which leaves π/4, or 0.785. A circle always covers 78.5% of the square it fits in, no matter how big it is.

> WORKED EXAMPLE A 12-inch pizza in a 12-inch box covers π × 6 × 6 = 113 of the box's 144 square inches, and 113 ÷ 144 = 0.785. That is why there is always some cardboard showing in the corners.

Shadows and the cosine

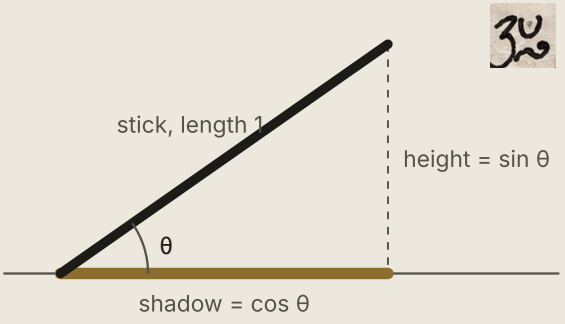
Hold a stick out flat under a lamp hanging straight overhead, and its shadow on the floor is just as long as the stick. Tilt the stick and the shadow gets shorter. The shadow's length divided by the stick's length is called the cosine of the angle you tilted it by. Held flat, the cosine is 1. Tilted 60°, it is 0.5. Pointed straight up at 90°, it is 0, and there is no shadow at all. For small tilts the cosine stays very close to 1, because a small tilt barely shortens the shadow. Tilt the stick 5.54° and the shadow is 99.53% as long as the stick, so only 0.47% is lost. The height the tilted stick rises off the floor is called the sine, and the sine divided by the cosine, which is the slope of the stick, is called the tangent.

A circle covers π/4 of its square



circle ÷ square = 0.785, or 78.5%

A tilted stick's shadow is the cosine



On the left, a circle that just fits in a square covers π/4, or 78.5%, of it, which is the sun's number. On the right, a stick tilted by an angle θ casts a shadow cos θ as long as the stick, which is Om's number. At the drawing's 5.54°, the shadow is 99.53% of the stick.



3.2 The small circle `height 0.69` LIGHT

The small circle is a zero, drawn in the one gap in the sun's rays. It stands for the still line that the two tilted waves are measured against, the one direction they both agree on. Next to it J.C. wrote the only word on the paper, *anja*. That is nearly *ajna*, the brow chakra in yoga's map of the body, which is where the two side channels meet and become one. The word means command.

> THE NUMBER 0, the line of no tilt.
>
> WHY LIGHT It is the line an observer of light measures along, so observing starts here. Below this mark there are still two waves, and above it there is only one number.

WHY NOTHING SITS AT ZERO Every motion keeps a leftover jiggle of half the smallest step it could take, even at absolute zero, and the paper counts with that half step (2.2). The engineer who writes as @TMBSPACESHIPS likes to say that zero states don't exist, and anyone who has tried to sit perfectly still through a ninety-minute meeting knows he's right.

KEEP THIS PICTURE IN MIND The sun has a small circle sitting in the one gap in its rays, and the same picture shows up again at Giza (7.3).

IN THE YOGA MAP Ajna is the third eye between the eyebrows, where the two side channels end and become one, and J.C. wrote its name beside this mark, spelled very nearly the Sanskrit way.

IN THE PAPER Section 3.11.



3.3 The sun with ten rays `height 0.785` LIGHT

The sun stands for the observer catching what it can. On the drawing it sits above the two waves, and its number is π/4, 0.785, which is also the height it is drawn at on the paper.

THE NUMBER π/4 = 0.785.

HOW YOU GET IT The physics version is about reading a signal, and darts make it easy to see. Throw a lot of darts at a board, aiming for the bullseye, with your misses scattering up, down, left and right in the ordinary random way, and measure how far each dart landed from the center. You can average those distances and then square the average, or you can square each distance first and then average. The first number always comes out at π/4 of the second, which Lord Rayleigh worked out in 1880. A light signal is like those darts, because light can wiggle in two directions across its path, so an instrument that reads light's size by its average catches π/4 of the full power reading. Radio engineers have used that number ever since.

WHY IT HAS TO BE LIGHT Light has exactly two directions to wiggle in because it has no mass. If it had even a tiny mass it would have a third, the factor would be 8/(3π) = 0.849, and the answer would miss by a mile.

THE TEN RAYS Empty space has ten dials at every point. Nine of them tell light which way to go and how fast, and the tenth sets how hard space pushes back on it, the 376.73 ohms of empty space. They are the same ten numbers Einstein used for the shape of space and time. Eric Weinstein's Geometric Unity starts by placing those ten dials over every point, and it measures them in a way that splits them four and six. Four out of ten is 2/5, the oval's number again, and in the same picture the four carry the symmetry of the Higgs field, which gives the electron its mass, while the six carry the symmetry that gives the proton nearly all of its mass. So the sun's ten rays may split into an electron side and a proton side. The paper offers this as a match of counts and doesn't claim to derive it.

ON THE PAPER The sun's center is drawn at 0.785 of the height, and π/4 is 0.7854.

IN THE YOGA MAP Sahasrara, the crown chakra, is drawn as a thousand petals spreading out like rays from the top of the head.

IN THE PAPER Section 3.12, and appendix C.4 for the ten dials.



3.4 Om and the two arrows height 1.00 LIGHT

Om is the output. The two waves arrive at the top as two arrows, each tilted 5.54° the opposite way, and Om adds them into one number. The tilts cancel and only the part the two arrows share is left, which is the cosine of 5.54°, or 0.9953. So the merge costs 0.47%, and 0.47% is the whole gap between the rough answer, 136.4, and the measured one, 137.036.

THE NUMBER cos 5.54° = 0.9953, which is a cost of 0.47%.

PICTURE IT Two friends push a stalled car from its two back corners, each pushing a little inward. The sideways parts of their pushes cancel each other out, and only the forward parts move the car. Each friend's forward push is the cosine of their angle, and at 5.54° they lose 0.47% of their effort.

WHY IT HAS TO BE A COSINE The measured value of α leaves very little room in this last step. The two arrows have to count equally, there have to be two of them, and the angle has to be an actual turn. That is how two states behave when they trade places with each other. You start in one of them, let it mix with its twin, and the share left in the first one after the turn is the cosine of the turn. If the energy leaked away for good instead, the way an atom gives off a flash of light, you would get a different number, and the measurement rules that out by tens of thousands of error bars.

WHY LIGHT This is the answer, 1/137, which is how hard light holds onto matter.

IN THE YOGA MAP Om is said to be the sound of everything at once, and on the drawing it sits above two arrows that never quite touch.

IN THE PAPER Section 3.13.

3.5 HYDROGEN'S SECOND FLOOR

Om in a real atom: hydrogen's second shell

The biggest step in the paper since the first edition of this guide is finding where the merge under Om actually happens. It happens inside the hydrogen atom, on what you could call its second floor.

Hydrogen's electron lives on floors that physicists call shells, and the higher the floor, the more energy it costs the electron to live there, a bit like rent. The ground floor has one room. The second floor has four rooms at exactly the same rent, one called 2s and three called 2p, which in nature only happens in hydrogen and in college dorms. In the 1920s and 1930s Wolfgang Pauli, Vladimir Fock and Valentine Bargmann worked out why. The pull between a proton and an electron has a hidden symmetry, and on the second floor it makes those four rooms behave like two little spinning arrows, each able to point one of

two ways. That makes the second floor the lowest one where the atom has a pair of two-way switches, and it is the same shell Arnold Sommerfeld was studying in 1916 when he named α.

Give the atom one sharp push along a line and the two arrows turn opposite ways, one by +5.54° and the other by −5.54°, which is the star's tilt `✡ the star · 0.41`. The 2s room is an even mix of the electron sitting on one side of the proton and on the other, so what is left in 2s after the turn is the average of the two turned arrows. That average is the cosine of 5.54°, or 99.53%, the same number as Om `ॐ Om · 1.00`. Of the four rooms, 2s is the only one that touches the proton, so the 99.53% is what remains at the proton's surface, which is where the paper says the grip gets recorded `☾ the crescent · 0.13`. The two 2p rooms that spin around the push line don't turn at all, just as the line itself doesn't `▽ the triangle · 0.25`.

The 0.93% that did turn has moved into 2p, and 2p is the room that glows. Within about a billionth of a second it drops to the ground floor and gives off a flash of ultraviolet light that Theodore Lyman found in 1906, and that light has been called Lyman-alpha ever since. So hydrogen's second floor was making a light called alpha long before anyone asked where α comes from. Physicists use this same nudge from 2s into 2p to detect hydrogen in that state, and Willis Lamb and Robert Retherford used it in 1947 to measure the tiny shift in hydrogen's levels that won Lamb a Nobel Prize.

The push that does this has to be just right. It has to come from outside the atom, because an atom can't turn its own second floor any more than you can lift yourself up by your own belt. It has to keep one direction and come out the same size every time, to within three-tenths of a percent, which rules out everybody who has ever parallel parked. And it has to be a blip lasting a few dozen attoseconds, a few dozen billionths of a billionth of a second. The paper's answer is that the push and the recording are the same thing. Recording the pair's grip at the proton's surface is the push that turns the shell, and it pushes with a strength equal to the grip it records, which is why the turn comes out as the square root of P. That is the same form John von Neumann gave to a measurement in 1932, and the measurement keeps a complete record of the 0.93% that turned and no record at all of the 99.07% that didn't.

> ON THE DRAWING `✡ the star · 0.41` the two arrows, turned ±5.54°; `• small circle · 0.69` the still line between them; `ॐ Om · 1.00` the 99.53% left at the proton's surface.
>
> CREDIT The hidden symmetry is Pauli's, Fock's and Bargmann's. The paper's attention to hydrogen's second shell was first prompted by the notes of @TMBSPACESHIPS.
>
> IN THE PAPER Sections 3.13 to 3.15.

PART 4 · THE EQUATION

The equation, all together

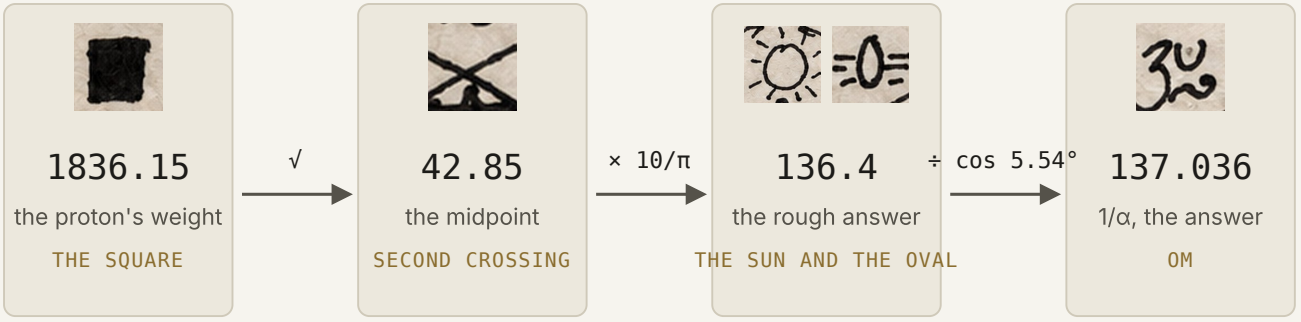
Multiply sound by light by frequency and you get α. This part writes it out, checks it against the best measurements, shows why a match like this doesn't happen by luck, and lists the assumptions it rests on, including the one step it still takes on trust.



4.1 THE RECIPE

Four steps up the drawing

Here it is in four steps, using the drawing's own marks. Start with the square's 1836.15. Take its square root and you get the second crossing's 42.85. Multiply by 10/π, which is the sun's π/4 and the oval's 2/5 folded into one number, and you get 136.4. Then the merge under Om adds its half percent, and you get 137.036.

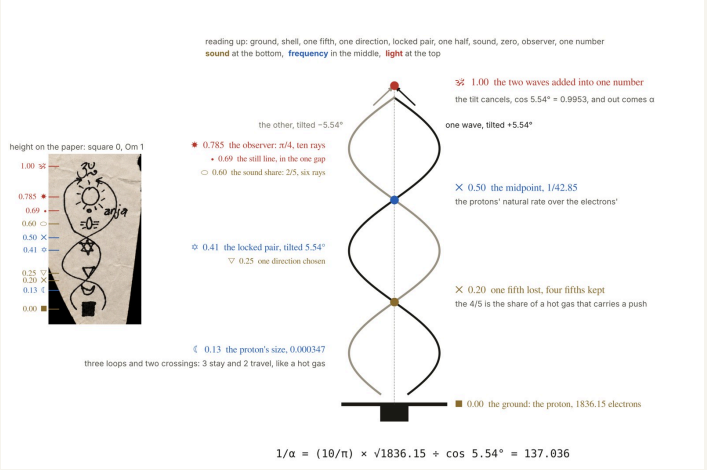


The whole equation in four steps, using the drawing's own marks. The square's 1836.15 goes in, its square root is the second crossing's 42.85, the sun and the oval together multiply that by 10/π, and Om's merge adds the last half percent.

$$1/\alpha = (10/\pi) \times \sqrt{(1836.15)} \div \cos(5.5357°) = 3.1831 \times 42.8504 \times 1.00469 = 137.035999164$$

Written out in full, with every mark in its place, the equation is $\alpha = (\pi/4) \cdot P \cdot \cos\sqrt{P}$, where $P = (2/5) \cdot \sqrt{q} \cdot (1 + (4/5)\rho^2)$, q is 1/1836.15 and ρ is the crescent's 0.000347. Every symbol in it is one of the ten marks, and the whole thing fits in seven lines of computer code, which the paper prints. The appendix at the end of this guide lists every mark with its height, its number and its meaning in one table.

The same equation can be said in speeds. The fine-structure constant is also how fast the electron in a hydrogen atom moves in its lowest state, as a share of the speed of light. It goes about 2,188 kilometers a second, which is 1/137 of light's speed. Meanwhile a proton and an electron at the same temperature move at speeds in the ratio 1 to 42.85, because the proton is heavier and lumbers. The equation says the first number is π/10 times the second, less the merge's 0.47%. So the only things that set the electron's speed inside the atom are the speed ratio of a proton and an electron in a hot gas, two fixed fractions and the tilt.



On the left is the drawing with each mark's measured height. On the right are the same marks as the two tilted waves of the equation, with sound at the bottom, frequency in the middle and light at the top.

4.2 THE CHECK

Why it isn't luck

Put in 1836.15 and the equation gives 1/α = 137.035999164. The best measurement ever made, from the magnetism of a single electron held in a trap at Northwestern University in 2023, gives 137.035999166 as published, and 137.035999165 once two theory terms that have been corrected since then are put in, give or take 16 in the last two digits either way. One error bar here is that give-or-take, which physicists call one sigma, written σ, and landing within one of them is a good match. The equation comes out 0.16 error bars from the first number and 0.09 from the second, which means it matches eleven digits in a row.

No formula for α has managed that before. Ever since Arthur Eddington in 1929, physicists and amateurs have been proposing formulas for α, and every one of them was either a numerical coincidence with no physics behind it or had something in it that was adjusted to fit. The core idea of this one is older still, and the credit for it belongs to other people. In 1915, the year before Arnold Sommerfeld named α, H. S. Allen noticed that it comes out close to the square root of the electron's mass over ten proton masses, and Eddington's work contains the same thing. Both are off by one or two percent. The drawing adds the π/10, the tilt and the crescent, which take it from one percent to eleven digits, and it gives every piece a physical job.

Four checks

1. The positions were measured off the paper. The crossings sit at 0.198 and 0.499 of the height and the sun sits at 0.785, and the equation needs 1/5, 1/2 and π/4, which is 0.785. Those heights put 1.00 at the top curve of Om. Put 1.00 at the middle of the symbol instead and they shift to 0.20, 0.51 and 0.81. Either way, a thirty-second sketch on an envelope has about 3% of slop in it, and all three are inside that. The math was written first and the paper was measured afterward.

2. Nothing can be adjusted. There is one input, the mass ratio, and no fitted constant. There are a handful of yes-or-no choices in building it, such as which of the electron's clocks to use, and the paper lists all nine along with what decides each one. Change any piece and the answer lands far outside the measurement's error bar.

`107.6` without the sun's π/4	`109.8` with ½ in place of the oval's 2/5	`136.397` without the merge under Om
`53σ off` with ¾ in place of the crossing's 4/5	`846σ off` without the crescent	`137.036` with every piece in place, 0.09σ from the best measurement

For a feel of the scale, imagine that one error bar is a centimeter. On that scale the equation comes out less than a millimeter from the center. Leave out the crescent and it misses by eight and a half meters. Use a plain average for the midpoint instead of the multiplying midpoint and it misses by 1.8 million kilometers, almost five times the distance to the Moon.

3. It is the only one of 67 million cousins that works. A fair worry is that with enough fiddling, anything can hit 137. So the paper built every formula of the same shape it could, swapping in other simple fractions, other powers of the mass ratio, other readouts, other merges and two thousand other crescent terms, 67 million formulas in all, and checked each one against α. Exactly one of them comes out within two error bars of the measurement, and it is this one. Then the paper ran the whole family against random numbers near 137 instead of α, to see how often one of them gets lucky, and that happened about once in 700 tries.

4. It predicts things that have nothing to do with the drawing. Run the equation backward and it says what size the proton has to be and how far its internal pressure reaches. Read the same step as energy and it says what Newton's G has to be. And it says α can only move if the mass ratio moves, in a fixed ratio. All of these are measured by people who have never heard of this drawing, and so far every one of them agrees. They are Part 5.

4.3 THE FINE PRINT

The five assumptions, and what would break it

A physicist will go after the assumptions, and the paper lists five of them in its section 9.1. Each one can be found on the drawing, and the paper says plainly that if the equation is wrong anywhere, the fourth assumption is the likeliest place.

ASSUMPTION	IN PLAIN WORDS	ON THE DRAWING
1	The coupling is the grip between the plasma's two waves, averaged with each kind of motion counted once, and measured with nothing moving around inside the plasma.	the two waves, ⬭ the oval, ✕ the second crossing
2	The proton's size comes in through its own pressure, measured at its charged surface.	☾ the crescent, ✕ the first crossing
3	The proton's size is measured in ticks of the electron's clock, using the full tick.	☾ the crescent
4	The grip gets recorded once, at the proton's surface, along one line, in a single event. Light picks up that event through charge, which gives α, and gravity picks it up through energy, which gives G.	▽ the triangle, • the small circle, ☀ the sun, ॐ Om
5	The proton and the electron are the only two charged particles that last, and they set the strength that every other particle inherits.	■ the square

The equation also says what would break it. A better measurement of α that misses 164 would break it (5.5), and so would a charged surface of the proton that turns out not to measure 0.652 fm (5.2), or α and the mass ratio caught moving in any ratio other than −2.01 (5.4). All three are being measured now.

4.4 THE OPEN STEP

The one step still taken on trust

Every piece of the equation now has a physical job, and the paper is clear about the one step it still takes on trust, which is how big the turn is. The measured α says the turn of the two arrows is the square root of P, 0.0966 radians, to within about one part in a hundred million. The paper explains why it should be a square root. For two states trading places, the chance of having crossed over goes as the square of the turn, so a grip of strength P turns them by √P. It also explains why the turn is counted in the proton's units, which is because the surface doing the recording belongs to the proton. The one thing it can't derive yet is a factor of two. Every way of counting the turn that the paper tested comes down to a choice between a whole and a half, such as an oscillator's full swing or half of it, the full angle or the half angle, or the peak or the average. Each time, the equation needs the whole one.

Nature is full of exact 2:1s, and the breadcrumbs point there. A spinning proton or electron has to turn all the way around twice, 720°, to come back exactly as it was. You can do a version of this with your own arm. Hold a plate flat on your palm and turn it all the way around, keeping it level the whole time. After one full turn your arm is twisted up awkwardly over your shoulder. Keep going the same way for a second full turn and your arm comes back untwisted, right where it started. Physicists call this the double cover, and neutron experiments by teams from Vienna and Missouri caught it happening in 1975. A swinging pendulum's energy of motion peaks twice in every full swing, since it passes the bottom once going each way. And Ralph Sansbury, in his book *Faster Than Light*, writes Planck's constant as twice the kinetic energy times the period of the motion, h = 2 × KE × T, which counts the whole swing, both halves of it.

The guess, which the paper labels as a guess, is that the proton's own 2:1 sets the unit. The proton needs two full turns to come back the way it was, so an event recorded at its surface may count the whole of that double turn, and counting the whole is the factor of two the equation asks for. If someone derives that step, the last open piece of the light reading is closed. The notes of @TMBSPACESHIPS and Sansbury's book both point at this corner of the problem, and nobody has walked that road all the way down yet.

> ON THE DRAWING `✡ the star · 0.41` the size of the turn; `ॐ Om · 1.00` the two arrows, each counted whole.
>
> IN THE PAPER Section 3.15, and item 4 of the open work in section 9.6.

PART 5 · PREDICTIONS

What else the same equation gets right

Getting α right is the headline, but an equation that only gives back the number it was aimed at could still be a lucky fit. This one also gives the size of the proton, how far its pressure reaches and the strength of gravity, it ties α to the mass ratio in a way clocks can test, and it calls the next digits of α. Each result comes from a mark on the drawing.



5.1 THE CRESCENT RUN BACKWARD

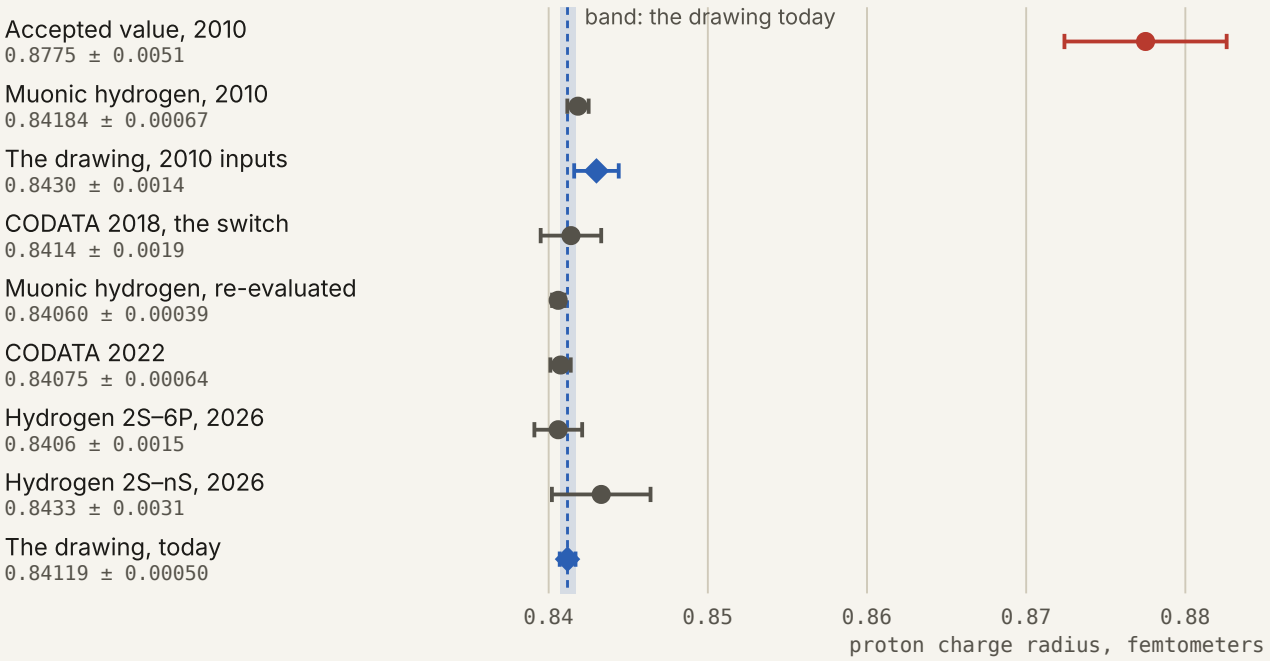
 The crescent: the size of the proton, 0.84119 fm

The crescent on the drawing is the proton's radius, and the equation needs it. Turn the equation around, feed in the measured α, and it tells you what the radius has to be, 0.84119 femtometers, give or take 0.00050. A femtometer is a millionth of a billionth of a meter. That number comes from α and the mass ratio, and no measurement of the proton's size goes into it.

The proton radius puzzle

For decades the proton's size was measured two ways, by shining lasers on ordinary hydrogen and by bouncing electrons off protons, and the answer was about 0.877 fm. Then in 2010 a team at the Paul Scherrer Institute in Switzerland swapped the electron in hydrogen for a muon, its 207-times-heavier cousin. A muon orbits about 200 times closer in than an electron, so it feels the proton's size far more strongly, and the team got 0.842 fm, four percent smaller and five error bars away from the accepted value. That gap became the proton radius puzzle. For years people argued about new physics, about mistaken constants and about hidden errors. One by one the newer hydrogen measurements came in small, the committee that sets the world's official constants switched to the small value in 2019, and in 2026 a hydrogen measurement reached 0.8406 fm, right on the muon's number.

Now run the drawing's equation backward using only what was known in 2010, the α and the mass ratio of that year. The crescent comes out at 0.8430 fm, give or take 0.0014. That is 0.7 error bars from the muon measurement and 6.5 error bars from the accepted value of the day. So a doodle from 1996 would have pointed to the small proton in 2010, the same year the puzzle started and nine years before the official value changed.



The proton's size since 2010, in femtometers, with one error bar either side of each point. The red point is the value accepted in 2010, built from electron scattering and ordinary hydrogen. The gray points are the measurements since then, muonic and ordinary hydrogen, and the official values. The blue diamonds are the drawing's crescent run backward from α, once with only 2010's inputs and once with today's, and the blue band is today's value with its error bar.

There is a second open argument in this corner of physics, and the equation connects the two. The two most precise measurements of α that use whole atoms, one with rubidium atoms in Paris and one with cesium atoms in Berkeley, disagree with each other by 5.5 error bars (5.5). The crescent is so sensitive that each of those α values gives its own

proton size when you run the equation backward. Rubidium's α gives 0.8399 fm, cesium's gives 0.8450 fm, and the electron's gives 0.8412 fm. The proton's measured size, 0.8406 fm, agrees with the electron's number. It disagrees a little with rubidium's, by 1.4 error bars, and a lot with cesium's, by more than four. So inside the equation, the argument over α and the argument over the proton's size are really the same argument, and settling either one settles the other.

More measurements are coming. Three experiments, PRad-II at Jefferson Lab, MUSE in Switzerland and AMBER at CERN, will measure the proton's size again by bouncing particles off it. At PRad-II's planned precision, the drawing's 0.84119 and the old 0.877 will be ten error bars apart. And if α is ever measured ten times better, the crescent will fix the proton's radius to ±0.00004 fm, which is more precise than any laser measurement on hydrogen has managed.

> THE EQUATION SAYS 0.84119 ± 0.00050 fm from today's α, and 0.8430 ± 0.0014 fm from 2010's.
>
> MEASURED 0.8406 ± 0.0015 fm (hydrogen 2S–6P, Maisenbacher et al., 2026), 0.37σ away; 0.84060 ± 0.00039 fm (muonic hydrogen, re-evaluated 2024), 0.9σ; 0.84075 ± 0.00064 fm (CODATA 2022), 0.5σ; 0.8433 ± 0.0031 fm (hydrogen 2S–nS, 2026), 0.7σ.
>
> ON THE DRAWING `☾ the crescent · 0.13`
>
> IN THE PAPER Section 4.2, with the 2010 value and the rubidium and cesium radii.

5.2 THE FIRST CROSSING RUN BACKWARD



The first crossing: the proton's pressure, 0.652 fm

A proton has more than one size, depending on what you measure. Its charge radius is how far its electric charge reaches. Its mechanical radius is how far its internal pressure reaches, the size of the part that pushes back when it is squeezed. The equation's 4/5 is a pressure term, and it fixes the mechanical radius at √(3/5) of the charge radius, which is 0.652 fm. This one doesn't use α at all, so it is a separate check. Jefferson Lab measured the pressure inside the proton for the first time in 2018 and has been refining the mechanical radius since.

There is one subtlety, and the paper spells it out. An electron sees the proton only through light, and light only sees electric charge, which the quarks carry and the gluons, the glue that holds the quarks together, do not. So 0.652 fm is the size of the proton's charged surface, its quark part. The whole proton, glue included, is bigger, and once the glue is measured, the equation says the whole proton should come out between 0.72 and 0.78 fm. The measurements of the whole proton so far come in at 0.72 to 0.75 fm.

> THE EQUATION SAYS 0.652 fm for the charged surface, and 0.72 to 0.78 fm for the whole proton with the measured glue.

> MEASURED 0.634 ± 0.057 fm (Jefferson Lab, Burkert et al., 2023), 0.3σ; 0.629 ± 0.026 fm (QCD sum rules, 2025), 0.9σ; 0.60 ± 0.12 fm (lattice QCD, quarks), 0.4σ; the whole proton, 0.72 to 0.75 fm.
>
> WHAT DECIDES IT A measurement of the charged surface to ±0.03 fm, which Jefferson Lab's 12 GeV program and the coming Electron-Ion Collider can reach.
>
> ON THE DRAWING `× first crossing · 0.198` the kept 4/5 of the proton's pressure, measured at `☾ the crescent · 0.13`, the proton's surface.
>
> IN THE PAPER Sections 3.3 and 4.2.

5.3 GRAVITY



The small circle and the crossings: gravity, G = 6.674282 × 10⁻¹¹

Newton's G is the number that sets how hard masses pull on each other. Two one-kilogram balls held a meter apart pull on each other with a force of 6.67 × 10^{-11} newtons, roughly the weight of a fine speck of dust. It is the worst-measured constant in physics, and the best labs disagree with each other by more than their own error bars. And nobody knows why gravity is so weak. Between a proton and an electron, the electric pull is 2.3 × 10^{39} times stronger than gravity, which is 23 followed by 38 zeros.

John Brandenburg built a whole theory around the drawing's midpoint, 42.85, which he calls a central number of the cosmos, and he restated it with Salvatore Pais in 2023. His formula says electricity beats gravity by e raised to twice 42.85, divided by α. (The number e, about 2.718, is the one that shows up whenever something grows or shrinks by the same fraction over and over, like money earning interest.) It comes very close, but it misses by 0.094%, which for G is 42 error bars.

Light and gravity pick up the same event

The paper now gets gravity out of the same event that gives α. When the grip between the proton and the electron gets recorded at the proton's surface, light picks up that event through electric charge, because charge is the only thing light responds to. Gravity picks up the same event through energy, because gravity responds to energy of every kind. Neither of those is a choice the paper made. Steven Weinberg proved back in 1964 that a massless field like light has to respond to charge, and a massless field like gravity has to respond to energy. Going by energy instead of charge changes two things.

First, energy doesn't point in any direction, so gravity takes in the whole proton, while light only takes in the part that lies across the line it reads along. Four-fifths of the proton lies across that line, and that part pays the merge's 0.47%. The other fifth lies along the line and pays nothing, because turning something around a line leaves the line itself where it was. Those are the first crossing's two fractions again, the 4/5 and the 1/5 `× first crossing · 0.198`. Put together, gravity's strength comes out at 1/136.9077, and the measured G asks for 1/136.9074.

Second, energy changes where the reading happens. Even sitting perfectly still, the proton keeps its small leftover jiggle `• small circle · 0.69`. Energy only changes hands in whole steps, and one step of the electron's energy is 42.85 of the proton's steps up `× second crossing · 0.499`. Gravity takes its reading up there, and the chance of the proton's jiggle reaching that high drops by a factor of about 7.4 with every step.



Gravity's stairwell. Light takes its reading at the bottom, at the center of the proton's jiggle. Gravity takes its reading at the top, one whole electron step up, which is 42.85 of the proton's own steps. At every step only about one in 7.4 of the jiggle gets past, so by the roof there is almost nothing of the proton left to read. On the drawing, the jiggle is the small circle and the 42.85 steps are the second crossing.

Think of a 43-story stairwell where, at every landing, only about one climber in seven keeps going up. Start with a full football stadium, about 100,000 people, and you would be down to your last climber around the sixth floor. Do the same arithmetic for all 42.85 steps and the share of the proton that reaches the roof is about 6×10^{-38}, which is the number Brandenburg wrote down, and now there is a reason for it. That is why gravity is so weak, and it is also why nobody has ever been crushed by a paperclip.

Put the two changes together, with nothing fitted, and you get $G = 6.674282 \times 10^{-11}$, 0.12 error bars from the accepted value. It also has something to say about the long-running disagreement over G, because it agrees with the University of Washington's 2000 measurement and with the official value, and it is far from the two best-known outliers.

The paper is upfront about the order in which this was found. The rule for where gravity takes its reading was written with Brandenburg's number already in view, and the 4/5 and 1/5 split was spotted after his 0.094% gap had been seen. Still, the split doesn't add any new number, and that is why it counts for more than a patch. The 4/5 and the 1/5 are the first crossing's own fractions, which the measured α alone fixes at 0.79991, and G asks for 0.799, give or take 0.005. And the fifth was already on the drawing, at the first crossing, back in 1996.

You can also run it the other way, starting from gravity. From G and the electron's mass, the equation gives back a proton 1836.1526 times heavier, 0.12 error bars from the measured ratio. Pais calls the Planck force, c^4/G, the Superforce, and in this reading it can be written in terms of the proton–electron pair as well.

> THE EQUATION SAYS $G = 6.674282 \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$.
>
> MEASURED $6.67430 \pm 0.00015 \times 10^{-11}$ (CODATA 2022), 0.12σ; Washington 2000, 0.3σ; NIST 2026 as announced, 1.1σ.
>
> WHAT WOULD BREAK IT G measured to a part in a million that disagrees, or G drifting by more than a few parts in 10^{17} a year while the mass ratio holds still.
>
> ON THE DRAWING `× first crossing · 0.198` the fifth gravity doesn't pay; `• small circle · 0.69` the jiggle; `× second crossing · 0.499` the 42.85 steps.
>
> IN THE PAPER Section 8, with the order in which its parts were found in section 8.6.

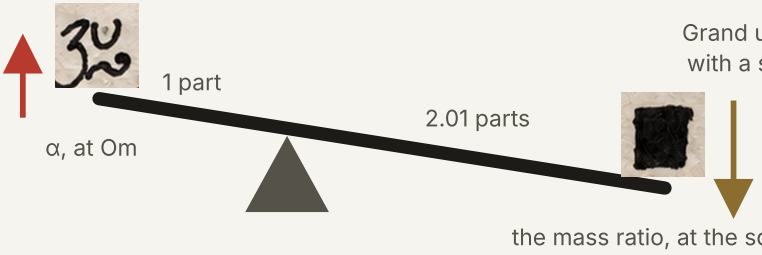
5.4 THE LOCK

The square and Om are locked together

Because the equation builds α out of the mass ratio and nothing else, α can only change if the mass ratio changes, and then by a fixed amount. If the proton-to-electron mass ratio ever moves by some small fraction, α has to move by 0.4977 of that fraction the other way. Turned around, the mass ratio always moves 2.01 times as fast as α, in the opposite direction. So if the mass ratio went up by one part in a million, α would go down by about half a part in a million. That last 0.01 comes entirely from the merge under Om, so catching the lock in the act would test the drawing's top step directly.

The drawing: 2.01 times as far, the other way

Grand unified theories: 30 to 40 times, with a sign that depends on the model



The lock, drawn as a seesaw. α sits at Om and the mass ratio sits at the square. If either one ever moves, the other has to move the opposite way, and the mass ratio always travels 2.01 times as far.

In the standard theory there is no such link. The electron gets its mass from the Higgs field, the proton gets its mass from the strong force, and α is a third number that has nothing to do with either. Theories that unify the forces say the mass ratio should move 30 to 40 times as fast as α, with a sign that depends on which theory you pick. The drawing says 2.01, minus sign included, so the first drift anyone sees will show which of them is right. Nothing has been seen to drift yet, so no test so far has checked the ratio itself.

WHEN AND WHERE	WHAT THE DATA SAY, READ THROUGH THE LOCK
Today, in the lab	Atomic clocks compared over years see no drift in either constant. Through the lock, the very tight limit on α becomes a limit on the mass ratio 72 times tighter than anyone has measured directly.
Seven billion years ago	Methanol in a galaxy whose light left it seven billion years ago shows no change in the mass ratio to about a part in ten million, so the lock says α from that time will show nothing bigger than about two parts in ten million.
Across the sky	Astronomers reported in 2011 that α seems slightly bigger on one side of the sky than the other, by about a part in 100,000. Through the lock, the mass ratio would then have to differ by twice that, and the two best mass-ratio measurements lie near that axis and show nothing of the kind, missing by 18 and 122 error bars. So the drawing says that difference isn't there, which is what corrected α measurements now find on their own.
The first light, 380,000 years in	The cosmic microwave background is the baby picture of the universe, the light let go when the first atoms formed. Read together with the DESI survey's new map of galaxy distances and run along the lock, it leans toward a world where the mass ratio was 0.58% smaller and α 0.29% bigger than today, preferred at 2.8 error bars. The same lean eases the Hubble tension, the disagreement over how fast the universe is expanding, from 5.7 error bars to 3.6, as some other changes to that era also do. So far that is only a lean, and it fades if you leave the DESI distances out.
Three minutes in	The helium and deuterium made in the first few minutes still fit, as long as it was the electron's mass that moved.

The instrument that could catch the lock directly now exists. The thorium-229 nuclear clock is about a thousand times more sensitive to α than atomic clocks and also responds to the strong force, so one working clock can watch both ends of the seesaw at once.

> THE EQUATION SAYS $\Delta\mu/\mu = -2.01\,\Delta\alpha/\alpha$, where μ is the proton-to-electron mass ratio, and any drift in a different ratio would break it.
>
> ON THE DRAWING `■ the square · 0.00`, the input, and `ॐ Om · 1.00`, the output.
>
> IN THE PAPER Section 6.

5.5 THE NEXT DIGITS

ॐ Om's next digits: the equation predicts 164

The rubidium and cesium measurements of α disagree with each other by 5.5 error bars, so at least one of them has a mistake nobody has found yet. The equation falls between them, right on top of the electron measurement, and it says the next digits are 164. Compared with it, rubidium reads high and cesium reads low, and whichever lab finds its problem, its corrected value should come out at 137.035999164. The Northwestern group behind the 2023 measurement is building a new apparatus aiming for ten times the precision, which will test the equation's eleventh digit.

THE EQUATION SAYS 1/α = 137.0359991638, give or take 12 in the last two digits, all of it from the uncertainty in the mass ratio.

MEASURED 137.035999165(16) from the electron's magnetism with current theory, 0.09σ, and 137.035999166(16) as published, 0.16σ; rubidium 137.035999206(11); cesium 137.035999046(27).

ON THE DRAWING `ॐ Om · 1.00`, the answer whose last digits these are.

IN THE PAPER Section 4.1.

PART 6 · THE OBSERVER

The observer and consciousness

The paper calls the top three marks the observer, and this guide takes consciousness to be that observer, meaning the act of taking a reading. Everything before this part is measured or derived, and all of it is in the paper. This part is about what the equation could mean if you take its shape seriously, and from here on it is speculation.



6.1 WHAT WE DROP

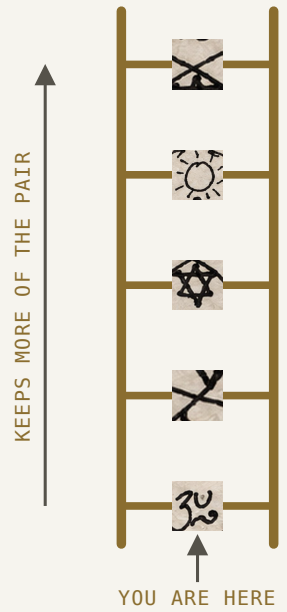
What every measurement drops

The last step of the equation throws something away. The two waves arrive leaning 5.54° in opposite directions `✡ the star · 0.41`, and the merge under Om keeps only the part they share `ॐ Om · 1.00`, so the lean, which is a difference in timing, cancels out. That costs 0.47%, and losing that 0.47% is what turns 136.4 into 137.036.

Our instruments measure how strong a signal is, and they throw the timing away, the way a photograph does (3.1). Every measurement of α we have works like a photograph. So 137.036 is what the proton and the electron look like to an observer that drops the tilt, and an observer that kept the tilt would see the same atom at 136.397. From here on, an observer that measures only how much of something there is will be called a strength observer, and an observer that also keeps the tilt will be called a tilt observer.

The rest of the equation is built out of steps like that one. Set the midpoint, 1/42.85, to one side, and every other piece multiplied onto it is a share of something that gets through to the observer. The 2/5 is the share of what can be known about the plasma's heat that travels away as sound `⬭ the oval · 0.60`. The π/4 is the share an observer catches when it measures a two-way wobble by its average size `☀ the sun · 0.785`. The cos

5.54° is the share left over after the tilt is dropped. If that reading is right, α is the atom, which is the midpoint, multiplied by the shares that reach the observer. Undo those steps one at a time and you get a ladder.



42.85	nothing dropped: the pair itself, with no observer
107.1	one that also follows the wobble instead of averaging it
136.397	an observer that keeps the whole tilt
136.907	gravity: it keeps the fifth of the tilt along the line
137.036	us: light and matter, every experiment we have

The ladder of observers. Each rung is what an observer would measure if it kept a little more of the proton and the electron than the rung below it, and the mark on each rung is the piece of the drawing it keeps. Gravity keeps the first crossing's fifth, the next rung keeps the star's whole tilt, the one above that also keeps the sun's wobble, and the top rung keeps the pair itself, the second crossing. We are on the bottom rung, at Om, along with every experiment we have ever built.

The bottom rung is measured, and so is the next one up, through G (5.3), which comes out 0.094% below the first. The rungs above those are what the equation says an observer would get if it kept each of those things instead of dropping them, and no instrument we have can read them. At the top, at 42.85, nothing is dropped at all. The two waves never merge, the sum and the difference are both there, and there is no 137, only the pair.

6.2 How much of the tilt we lose FREQUENCY

The last step drops the tilt between the two waves, and you can work out how much information goes with it. Physicists measure information with something called Fisher information, which is how much a measurement can tell you about something. A sharp photo of a license plate carries a lot of it, and a blurry one carries very little. Draw the pair as a point on a circle, tilted 5.54° off the line. A strength observer only gets the part along the line, and that part carries $\sin^2 5.54°$, about 1%, of the information about how big the tilt is, and none at all about which way it leans. To figure out the size of the tilt from that alone you would need about 107 separate looks, and no number of looks would ever tell you which way it leans. In hydrogen's second shell the same numbers are physical (3.5). There, 0.93% of the pair turns and gets recorded, and that is the part that can later glow as Lyman-alpha, while the other 99.07% stays put and leaves no trace at all.

WHAT IT MEANS A tilt observer would get about a hundred times more information about the tilt than we do, plus the one thing we can never get, which is the direction it leans. We get the sum of the two waves, and it would get both the sum and the difference.

WHAT IT SAYS ABOUT TIME The equation has a count in it, the ratio of the two rates, and that count survives the merge. It also has the tilt, which doesn't survive. You can think of the count as clock time, one tick after another. The tilt is about which way and when, the part that makes one moment different from the next in a way a clock can't record. So a strength observer like us keeps track of clock time and loses that other part.

EVERY PIECE IS AN EXTREME The midpoint is the halfway point in the information distance between the two masses, the 2/5 comes from sharing the energy as evenly as possible, the π/4 is the readout of the most random kind of light, and the merge is the fastest change the information budget allows.

6.3 Consciousness as the observer LIGHT

In this reading, consciousness is the observer, meaning the act of taking a share of what the atom has to give. If that is right, a mind would show up as some of the factors in the most precisely measured number in physics, and you could point to which ones. One of the leading scientific theories of consciousness, integrated information theory, measures consciousness in information too, by how much information a system takes in and ties together, so the equation and the theory could be counting the same thing. An observer that keeps more would sit higher on the ladder, looking at more of the same universe we see.

THE TOP OF THE LADDER If the words "universal consciousness" mean anything in this equation, they could mean the observer at the top, the one that drops nothing. That observer would be observation with nothing left out, the whole pair at once, sum and difference, everywhere the pair is, which means everywhere there is hydrogen. Every particular observer, us included, would be a share of that same observation with some of it dropped, and everything we measure would be what is left once the tilt is gone.

THE OTHER LIMIT Now try the opposite extreme and set the two masses equal. The midpoint goes to 1, the tilt goes to zero, and the equation gives $\alpha = \pi/10$. A pair whose two halves are identical has nothing to tell anyone, though, because information comes from differences and there aren't any. So at that limit there would be nothing to observe at all.

WHAT FOLLOWS For any one observer, observing seems to require dropping something, and the consciousness we have lives inside that trade. A more conscious observer would drop less. Only the observer at the top of the ladder drops nothing, and that one would be the whole of the observing going on everywhere at once.

6.4 Other phases of the same world FREQUENCY

In this equation, "out of phase" has an exact meaning. Take the same proton and electron and read them with the tilt kept instead of dropped. The atoms are identical either way, but the information you get from them changes. A strength observer gets how much of something there is, and a tilt observer gets how much, which way and when. That is a different kind of data, the way a photograph and a hologram of the same room record different things. Two observers in different phases could stand in the same room, made of the same atoms, and never see each other's information, because each one keeps a different share. That may be what people mean by another phase of reality, the same world with a different amount dropped.

> THE COST Dropping the tilt costs 0.47%. An observer one rung up would see the same atom bound 0.47% tighter and would get the 99% of the tilt we never collect.

6.5 Other particle pairs would make other worlds SOUND

The ladder is one way an observer could differ from us, and the pair itself is another. The equation works for any heavy-and-light pair, and the proton and the electron are only one example. In our world every particle shares the one α that the proton and the electron set, since they are the only two charged particles that last, but a world built on a different pair would get its own α and its own tilt. The pairs that tilt more grip each other harder, and they don't last. The pairs that tilt less last longer and give less to observe. Hydrogen is the one place on the list where the grip is as strong as it can be while the pair still holds together.

> THE NUMBERS An electron with its own antiparticle tilts 42°, pays 25%, has an α of about 1/3, and the pair destroys itself in a fraction of a second. A muon with a proton tilts 21°, pays 6.7%, has an α of about 1/10, and the muon decays in two millionths of a second. A proton with an electron tilts 5.5°, pays 0.47%, has an α of 1/137, and lasts forever. Deuterium, the heavy form of hydrogen, gives 1/193, and helium gives 1/272.
>
> THE SAME A IN A DIFFERENT WORLD The equation only sees the ratio of the two masses, and never the masses themselves. So a pair of lasting charges with our 1836.15 ratio at a different size would give exactly our α. Picture a stable charge as heavy as a muon with a partner 1836 times heavier still, at 194 GeV. It would build atoms just like ours, only 207 times smaller, and every clock in that world would run 207 times faster. Since all of its physics would come out in its own units, an observer living inside it could never tell its size or its pace from ours. That may be the most exact version this guide can give of the idea of another space-time reality, with the same α and the same chemistry, played out at a different scale by a different pair.
>
> ON THE DRAWING `■ the square · 0.00` the heavy one, which sets the tilt; `✡ the star · 0.41` the tilt.

6.6 The drawing is the chakra column SOUND FREQUENCY LIGHT

Read from the bottom up, the drawing's marks are the traditional chakra symbols in their traditional order. The square is the root, a yellow square. The crescent is the sacral, a crescent moon on its back. The downward triangle is the solar plexus, a triangle of fire pointing down. The six-pointed star is the heart. The oval is the throat, a full moon. The small circle is the third eye, and J.C. wrote its name beside it. The sun is the crown, a thousand petals spreading like rays, and Om sits on top. The two waves wind up around the center and cross between the chakras the way ida and pingala do in every yoga book. The old Sanskrit text the modern chakra pictures come from, the *Ṣaṭ-cakra-nirūpaṇa* of 1577, describes these same symbols, and Arthur Avalon translated it as *The Serpent Power* in 1919.

> WHAT IT COULD MEAN If the reading in this guide is right, the yoga map of the body and the physics map of the equation line up mark for mark. The root is the input, the proton, the heart is the tilt, the throat is the sound, the third eye is the still line where the two channels meet, the crown is the observer, and Om is the number. Read that way, the old map of the body is also a map of how matter gets observed, and its place of seeing is the spot where the drawing puts its only word.

6.7 Near-death reports LIGHT

The strength observers we know best are our own bodies and senses. When the body stops for a while and then starts again, the people who come back describe the same few things over and over: everything at once, no clock running, both sides of every question understood together, and a feeling they call truth or love. This guide can't test those reports, but they are close to what a tilt observer would describe.

> HOW THE REPORTS LINE UP Holding the sum and the difference together would feel like "everything at once." Losing the count would feel like losing the clock. And keeping which way and when would mean keeping the moment itself, which is the part a strength observer like us loses.

6.8 How it gets tested FREQUENCY

Every measurement of α ever made measures strength and nothing else, so nobody has ever measured the tilt on its own. What can be watched is the thing that sets it, the proton-to-electron mass ratio. If that ever drifts, α has to drift by about half as much the other way, and atomic clocks and the new thorium nuclear clock are watching for it (5.4). Gravity gives a second way to check. It is the one reader we know of that keeps part of the tilt, and every better measurement of G tests whether it keeps a fifth.

> THE PREDICTION An observer that keeps the tilt gets 0.47% more coupling than one that measures strength alone, gravity keeps the fifth along the line, and α never moves unless the mass ratio moves.

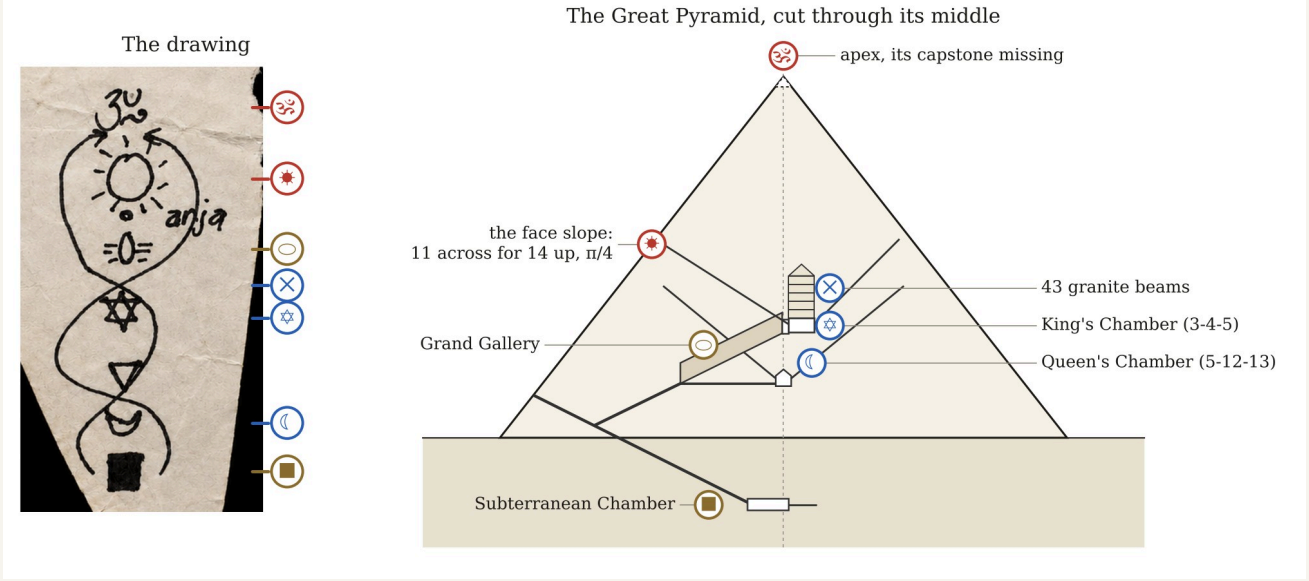
> ON THE DRAWING `■ the square · 0.00` and `ॐ Om · 1.00`, the input and the output that the clocks are watching; `× first crossing · 0.198`, the fifth that gravity keeps.

PART 7 · GIZA

The same equation, built at Giza

Cut through its middle, the Great Pyramid stacks its rooms the way the drawing stacks its marks, and the plateau carries the same numbers in the same order, sound under the ground, frequency at the surface and light above. None of this is needed to get α, but all of the sizes and angles here were measured, by Flinders Petrie in 1883 and by everyone since.





The drawing beside the Great Pyramid, cut through its middle. Both are a stack on one upright line, from a square at the bottom to a peak at the top, and the same marks land on the parts that play the same roles: the Subterranean Chamber is the ground (■), the Queen's Chamber the shell (☾), the King's Chamber the locked pair (✡), the 43 granite beams above it the midpoint (×, since √1836.15 is 42.85), the Grand Gallery the oval (⬭), the sloping face the sun's π/4 (☀), and the missing capstone the output (ॐ).

Every item below is tagged sound, frequency or light and points back to a mark on the drawing. One unit to know: the builders measured in royal cubits, and a cubit is 0.5236 m, about the length of a forearm.

Under the ground and in the chambers

The drawing starts at the ground and so does the plateau. The half below the surface is the half everyone skips, and it is the sound half, with the Earth as the heavy thing pushing up.

The Earth's hum, 7.83 Hz SOUND FREQUENCY

Lightning strikes somewhere on Earth about fifty times a second, and every strike rings the gap between the ground and the upper air like a bell. Since the lightning never stops, neither does the ringing. It is called the Schumann resonance, and its lowest note is 7.83 cycles a second. You can't hear it, because it is a radio wave rather than a sound, but it is the planet's own ground note, and any decent radio receiver can pick it up.

> ON THE DRAWING `■ the square · 0.00` The proton is the slow, heavy half of a hydrogen atom, and the Earth is the slow, heavy half of the plateau.

The Subterranean Chamber SOUND

The Great Pyramid's lowest room is cut 30 m straight down into the bedrock under the center of the building, reached by a passage that slopes down from the north face, and it was never finished. No burial was ever found in it. In Christopher Dunn's reading of the pyramid as a machine, this is the input, where the Earth's vibration comes in. Two pieces of lab physics say something does come in. Friedemann Freund at NASA showed that rock under stress gives off electric charge, and in 2018 a team in St Petersburg and Hannover ran the Great Pyramid through the math used for radio antennas and found that it concentrates radio waves of 200 to 600 m wavelength into its chambers and into the rock under its base.

> ON THE DRAWING `■ the square · 0.00` the one room below everything else, the way the square sits below every other mark.

Khafre's faces are a 3-4-5, and Menkaure's profile is 4/5 SOUND

The second pyramid rises 4 for every 3 across. That is the 3-4-5 triangle, the one builders have always used to make a right angle, because $3^2 + 4^2 = 5^2$. Divide each short side by the long one and you get 3/5 and 4/5, and 4/5 is the share the equation keeps at the first crossing. The third pyramid rises 5 for every 4 across, so its half-base divided by its height is exactly 4/5, the same fraction built as a whole pyramid.

> THE NUMBERS Khafre's slope is 53°10′, and Menkaure's design slope is 51°20′, with Petrie measuring the granite casing at 51°0′ ± 10′.
>
> ON THE DRAWING `× first crossing · 0.198` the 4/5 and the 1/5.

Khufu's three small pyramids are the one-fifth SOUND

On the Great Pyramid's east side, three small pyramids stand in a row. They are 46 to 49 m on a side, against Khufu's 230 m, which is one-fifth of him, give or take a few percent. The fifth is the share you lose when you read along one line, and here it stands next to the thing it was taken from. As for why there are three, a ball carries a fifth of its spread along each of its three directions, and the equation lets go of one of them.

> ON THE DRAWING `× first crossing · 0.198` the fifth that is set aside.

The King's Chamber is a 3-4-5 box SOUND FREQUENCY

The main room inside the Great Pyramid is 10 cubits wide and 20 cubits long, and its height is 5√5, which is 11.18. Those three numbers make the room's diagonals 15 and 25, so the room is a 3-4-5 triangle in three dimensions, and Petrie's survey matches it to within an inch. The 10 by 20 floor is also "one turn over twenty," since 2π is one full turn around a circle, and the whole equation in its shortest form is $\alpha = 2\pi/20 \times \sqrt{(1/1836.15)}$. That form is good to half a percent, and the half percent is the merge under Om. The room is built entirely of granite, and when visitors hum or chant in it the whole room rings.

> HOW YOU GET IT A width of 10 and a height of 11.18 make the end wall's diagonal 15, because $\sqrt{(10^2 + 11.18^2)} = 15$. Add the length of 20 and the corner-to-corner diagonal is 25, and 15-20-25 is 3-4-5 times five.
>
> ON THE DRAWING `✡ the star · 0.41` The star is two triangles locked into one shape, and this room is two right triangles locked into one box.

The Queen's Chamber is a 5-12-13 FREQUENCY

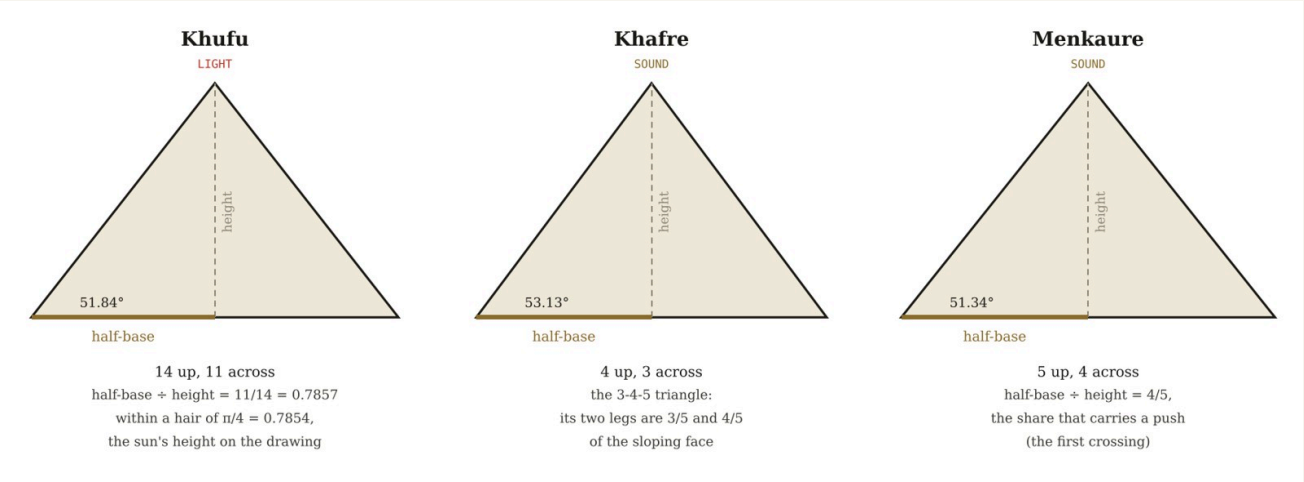
The smaller room below it is 10 cubits wide with a pointed roof 12 cubits above the floor. Cut the room down the middle and each half is a triangle 5 wide and 12 tall, and the line from a floor corner up to the ridge is 13. That is the next right triangle after 3-4-5, and it is the second triangle hidden in the equation's fifths, because $5^2 = 12 + 13$.

> ON THE DRAWING `☾ the crescent · 0.13` the shell, and in Dunn's reading the room where hydrogen was made (7.4).

Five stacked rooms and 43 beams SOUND FREQUENCY

Over the King's Chamber there are five low compartments stacked one on top of another, roofed with 43 granite beams in all, each weighing tens of tons. Five is the number that runs through the whole equation, since a hot gas moves in five kinds of way and the 2/5 and the 4/5 are shares of those five (1.5). And 43 is the midpoint, because √1836.15 = 42.85.

> ON THE DRAWING `⬭ the oval · 0.60` for the five; `× second crossing · 0.499` for the 43.



The three big pyramids in profile, drawn to the same height so the slopes can be compared. Khufu carries the sun's π/4, and Khafre and Menkaure carry the 4/5 that the first crossing keeps.

7.2 FREQUENCY

The surface and the Sphinx temple

The middle of the drawing is a midpoint and a tilt, which are timing numbers. The middle of the plateau is the ground you stand on, and it is a midpoint too.

The surface is the midpoint between the Earth's hum and hydrogen's radio note FREQUENCY

Below the surface is the Earth at 7.83 cycles a second. Above it is hydrogen's own radio note, the 1,420 million cycles a second that a hydrogen atom gives off when its electron flips over, which is how astronomers map hydrogen across the universe and the frequency people listen on when they search the sky for anyone else. Take the drawing's midpoint rule, the midpoint counted by multiplying (2.1), and apply it to those two. The answer is 105,000 cycles a second, a long radio wave about 3 km from crest to crest, so the plateau's surface sits at the second crossing.

> HOW YOU GET IT √(7.83 × 1,420,000,000) = 105,000. Hydrogen's note itself is built from α and the mass ratio, the two numbers the drawing turns into each other: it is α^4 times 1/1836.15 times the electron's own clock rate, times a fixed factor for the proton's magnetism.
>
> ON THE DRAWING `× second crossing · 0.499` the heavy end below, the light end above, and the crossing at the surface.

The passages climb one in two FREQUENCY

Every sloping passage inside the Great Pyramid climbs 1 for every 2 along. That includes the one going down to the Subterranean Chamber, the one going up, and the Grand Gallery, and they agree with each other within seven minutes of arc. One half is the second crossing's height on the paper. Double that slope's angle and you get the 3-4-5 angle of Khafre's faces.

> ON THE DRAWING `× second crossing · 0.499`

The Sphinx temple's 24 pillars FREQUENCY

In front of the Sphinx is a temple with a courtyard ringed by twenty-four square pillars, and two small sanctuaries, one on the east side and one on the west. Herbert Ricke and Mark Lehner read it as a sun temple, with twenty-four pillars for the twenty-four hours and one sanctuary for sunrise and one for sunset. A building that counts the day is a clock, and this clock runs at a frequency of one cycle a day.

> ON THE DRAWING `☀ the sun · 0.785` the sun's day, counted out in stone.

The Golden Cut of the plan FREQUENCY

Measure from the center of Khufu south to a line that lies just inside Khafre's north edge, and then from that line south to the center of Menkaure. The two distances are 540 and 871 cubits, and 871 ÷ 540 = 1.613, which is the golden ratio, 1.618, to a third of a percent. A golden cut is a midpoint rule counted by multiplying, the same kind of midpoint as the second crossing.

> ON THE DRAWING `× second crossing · 0.499` the same rule, drawn on the ground.

7.3 LIGHT

The sun, the 137s and the gap

The top of the drawing is a sun, a small circle in the gap in its rays, and two arrows becoming one. The plateau's upper half is built around the actual sun.

Khufu's profile is π/4, the sun's number LIGHT

The biggest building on the plateau is built 11 across for every 14 up, because half its base is 220 cubits and its height is 280. The fraction 11/14 is π/4 to four parts in ten thousand, which is the readout under the sun on the drawing. The whole Great Pyramid is built to the sun's number.

> THE NUMBERS 220/280 = 0.7857, and π/4 = 0.7854, from Petrie's base of 440 cubits and height of 280.
>
> ON THE DRAWING `☀ the sun · 0.785`

Khafre is built out of 137s LIGHT

The second pyramid's base is 411 cubits and its height is 274, and 411 is 3 × 137 while 274 is 2 × 137. Turn those into meters and you get 215.26 m and 143.5 m, which is what the surveyors measure. 137 is the fine-structure constant turned upside down, and it is a prime number, which no cubit rule, slope or building method produces on its own.

> ON THE DRAWING `ॐ Om · 1.00` the output, 137, laid out as a building.

Khufu to Menkaure is eight 137s LIGHT

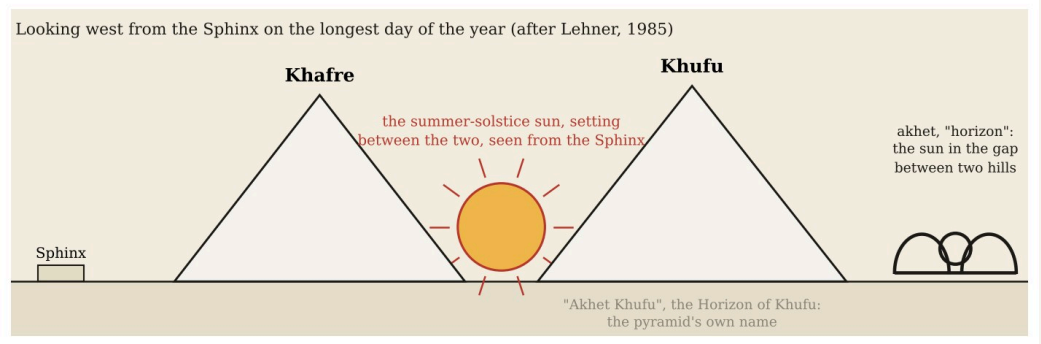
From the center of the Great Pyramid west to the center of Menkaure's is 1,096.8 cubits in Petrie's survey. Eight times 137.04 is 1,096.3, so the two ends of the plateau are eight α units apart, to 0.05%. A line through the south-east corners of all three big pyramids also runs north-east straight toward Heliopolis, the city of the sun god, as Mark Lehner noticed in 1985.

> ON THE DRAWING `ॐ Om · 1.00` the 137s; `☀ the sun · 0.785` the line to the sun's city.

The midsummer sun sets in the gap between Khufu and Khafre LIGHT

Stand at the Sphinx on the longest day of the year and look west, and the sun goes down in the gap between Khufu and Khafre. That picture, a disc between two hills, is the Egyptian hieroglyph *akhet*, which means horizon, and the Great Pyramid's own name was Akhet Khufu, the Horizon of Khufu. Now look at the drawing again. It has a sun with ten rays and a small circle sitting in the one gap between them, with the word *anja* next to it. The plateau built that gap at full scale and puts the sun in it once a year.

> ON THE DRAWING `• small circle · 0.69` in the gap of `☀ the sun · 0.785`.



Looking west from the Sphinx on the longest day of the year. The sun sets between the two big pyramids, which is the hieroglyph for horizon. The drawing has the same picture: a sun, and a small circle in the one gap in its rays.

Khufu's two sun boats LIGHT

On the Great Pyramid's south side there are two sealed pits, and in 1954 one of them was opened. Inside was a full-size cedar boat, taken apart into 1,224 pieces, which has since been rebuilt. It is about 43.5 m long, and the second pit holds its twin. The Egyptians gave the sun two boats, one to carry it across the sky by day and one to carry it back under the earth by night, so it is the same sun going one way and then the other. That is the same picture as two waves, one leaning each way, carrying one light between them.

> ON THE DRAWING `ॐ Om · 1.00` the two arrows under Om, one at +5.54° and one at −5.54°, that become one.

7.4 DUNN'S POWER PLANT

The Great Pyramid as a hydrogen machine

Christopher Dunn is a master machinist who spent decades making precision parts, and in 1998 he published *The Giza Power Plant*, which reads the Great Pyramid as a machine. It belongs here because the machine he describes works in the same three steps as the equation, in the same order, sound in, frequency in the middle and light out, and it runs on hydrogen, which is the atom the equation is about.

Step one: the Earth's vibration comes in and becomes sound SOUND

In Dunn's reading, the Subterranean Chamber takes in the Earth's vibration and the Grand Gallery turns it into sound. The Gallery is a tall sloping hall with 27 pairs of slots cut into its side ramps, and Dunn says the slots held resonators, tuned boxes that ring at a chosen note like the body of a guitar. The slots are real and nobody knows what they were for. The resonators are his idea.

> ON THE DRAWING `■ the square · 0.00` for the input, and the two waves rising out of it for the Gallery.

Step two: the Queen's Chamber made hydrogen FREQUENCY

The Queen's Chamber has two narrow shafts that don't reach the outside of the pyramid, which is strange for air shafts. Dunn reads them as pipes, with a weak solution of hydrochloric acid coming down one and hydrated zinc chloride down the other, so that when the two met in the room they reacted and gave off hydrogen gas. Three things he points to are real. The walls of the room were crusted with salt, up to half an inch thick, when the first explorers got in, and modern tests found sodium chloride and gypsum in it, which is what acid eating limestone leaves behind. In 1993 a robot found that the southern shaft ends at a small stone door with two copper fittings on it, and

nothing like that exists anywhere else in the pyramid. And hydrogen is the lightest gas there is, so if it was made here it would rise up the passage into the King's Chamber on its own.

> WHAT IS MEASURED AND WHAT IS HIS The salt, the copper fittings and the dead-end shafts are measured. The acid, the zinc and the reaction are Dunn's reading.
>
> ON THE DRAWING ☾ the crescent · 0.13 the shell, the room right above the ground, and the gas it makes is what the two waves are made of.

Step three: the King's Chamber turned sound into light at hydrogen's frequency FREQUENCY LIGHT

The King's Chamber is built entirely of granite, and granite is about half quartz. Quartz makes a voltage when you squeeze it, which is how a quartz watch works. In Dunn's reading, the sound from the Gallery shook the granite, the granite made an electric field, and the hydrogen filling the room was pumped up by that field. Then a signal fed in through the northern shaft at hydrogen's own frequency, 1,420 MHz, made the hydrogen answer at the same frequency, and the microwaves went out through the southern shaft as a beam. A device that does that is a maser, a microwave laser. Hydrogen masers are real, and they have been built since 1960 as some of the most stable clocks there are. In his reading the pyramid is a hydrogen maser the size of a building.

> WHAT IS MEASURED AND WHAT IS HIS The granite, the quartz, the dead-end shafts and the five stacked rooms above the chamber are measured. The maser is Dunn's reading.
>
> ON THE DRAWING ✡ the star · 0.41 the room, where the two things are locked together, and ॐ Om · 1.00 what comes out of it.

Put the three steps next to the three words. The Earth's vibration comes in and becomes sound in the Gallery, the Queen's Chamber makes hydrogen and the King's Chamber tunes it to one frequency, and light goes out at that frequency. That is sound, then frequency, then light, from the ground up, in a building whose rooms carry the drawing's fractions. If his reading is right, the building is in that order, and Dunn saw it first.

7.5 THE TILT AT GIZA

The star's tilt at Giza

Part 6 said that the last step of the equation drops the tilt and that gravity keeps a fifth of it. Three things on the plateau look like the same split, built in stone. The device Dunn describes for the King's Chamber is a maser, and a maser works by getting every atom in it to give off its light in step with all the others, the way a crowd clapping in unison is different from scattered applause. So the one machine anyone has proposed for that room keeps hydrogen's waves in step, which means it would keep the tilt. The fifth that gravity keeps is a building too, since Khufu's three small pyramids are each a fifth of him while

Menkaure's whole profile is the other 4/5. And the plateau is full of exact 2:1s, the kind section 4.4 is looking for: the King's Chamber floor is two squares side by side, every passage climbs 1 for every 2 along, Khafre's height is 2 × 137 on a base of 3 × 137, and Khufu went into the ground with two boats for one sun.

The profiles, the chambers, the passages, the boats, the solstice line, the salt and the Sphinx temple's pillars are measured and on the record. Dunn's machine is his reading, and the sun-temple reading of the Sphinx temple is Ricke's and Lehner's. Khafre's 137 is a prime number, and nothing about how the builders worked produces a prime by itself. This guide doesn't say who built any of it, or why.

PART 8 · THE PAPER

The paper, and the people this is built on

The technical paper, with every derivation, every measurement and every alternative that was tried and rejected, is a 110-page preprint, version 1.11, dated October 26, 2026, with a permanent DOI. The link below always opens the newest version. This guide follows it closely, and the boxes marked "In the paper" give the section of the paper that covers each point.

McCracken, G. (2026). A relation for the fine-structure constant and Newton's constant from the proton–electron mass ratio alone. Version 1.11. Zenodo. doi:10.5281/zenodo.23370839

The main result can be checked with seven lines of code printed in the paper's appendix. The scripts behind every number, the test protocols that were fixed before each test was run, and the records of the checks made on them come with its source files.

REFERENCE PAGE A

Every mark and every number, at a glance

The table lists the ten marks from the bottom of the drawing to the top, with each one's measured height on the paper, its number in the equation, what it means, its word and its place in the yoga map of the body. The second table lists the equation's main results next to the measurements.

MARK	HEIGHT	NUMBER	WHAT IT MEANS	WORD	YOGA MAP
🕉 **Om, two arrows**	1.00	cos 5.54° = 0.9953	the two tilted waves are added and the tilt cancels, leaving 1/137	light	Om
☀ **the sun, ten rays**	0.785	π/4 = 0.785	the readout: how much of a two-way wobble an observer catches by its average size	light	crown

• the small circle	0.69	0	the still line the two tilted waves are measured against	light	third eye
⬭ the oval, six rays	0.60	2/5	the share of the plasma's heat energy that travels as sound	sound	throat
✕ second crossing	0.499	√1836.15 = 42.85	the midpoint, counted by multiplying	frequency	channels cross
✡ the star	0.41	5.54°	the tilt: how far each wave leans away from the center line	frequency	heart
▽ the triangle	0.25	none	one direction chosen to read along	sound	solar plexus
✕ first crossing	0.198	1/5 → 4/5	the share set aside when you read along one line, and the share kept	sound	channels cross
☾ the crescent	0.13	0.000347	the proton's size, in the electron's own unit of length	frequency	sacral
■ the square	0.00	1836.15	the proton, and the only number you put in	sound	root

RESULT	THE EQUATION SAYS	MEASURED	DISTANCE
1/α (4.2, 5.5)	137.0359991638 ± 12 in the last two digits	137.035999165 ± 16, electron, current theory; 137.035999166 ± 16 as published	0.09σ; 0.16σ
Proton radius (5.1)	0.84119 ± 0.00050 fm	0.8406 ± 0.0015 fm, hydrogen 2026; 0.84060 ± 0.00039 fm, muonic hydrogen	0.37σ; 0.9σ
Proton radius from 2010's inputs (5.1)	0.8430 ± 0.0014 fm	0.84184 ± 0.00067 fm, muonic hydrogen 2010; 0.8775 ± 0.0051 fm, accepted in 2010	0.7σ; 6.5σ
Mechanical radius, charged surface (5.2)	0.652 fm	0.634 ± 0.057 fm, Jefferson Lab 2023	0.3σ
Newton's G (5.3)	6.674282×10^{-11} m^3 kg^{-1} s^{-2}	$6.67430 \pm 0.00015 \times 10^{-11}$, CODATA 2022	0.12σ
The lock (5.4)	Δμ/μ = −2.01 Δα/α	no drift seen in either constant yet	not yet tested
Next digits of 1/α (5.5)	...164	rubidium ...206 ± 11; cesium ... 046 ± 27	to be settled

Inside numbers: the mass ratio is 1836.15267, its square root is 42.8504, P = (2/5) × (1/42.8504) × (1 + (4/5)ρ²) = 0.0093348, the tilt √P is 0.096617 radians or 5.5357°, its cosine is 0.995336, and gravity's version of the coupling, with the fifth kept, is 1/136.9077. Keeping the tilt gives 136.397, and the plain midpoint with nothing dropped is 42.85.

Words used in this guide

α, the fine-structure constant

A pure number, about 1/137.036, that measures how strongly light and electric charges grab onto each other. It has no units, so it comes out the same in any system of measurement.

Proton and electron

The two parts of a hydrogen atom. The proton is positive and heavy, the electron negative and light, and they are the only two charged particles that last.

Mass ratio

How many times heavier the proton is than the electron, 1836.15. It is the equation's only input.

Plasma

A gas so hot its atoms have come apart into loose protons and electrons. The sun is made of it.

Wavelength, frequency, hertz

The distance from one crest of a wave to the next, how many crests pass each second, and the unit for that, which means per second.

Phase

The timing of a wave, pictured as which way a turning arrow points. Two waves a little out of phase are a little out of step.

Radian

A way of measuring angles in which a full turn is 2π, about 6.283. One radian is about 57.3°.

Cosine, sine, tangent

For a stick tilted by some angle, the cosine is how long its shadow is, the sine is how high it rises, and the tangent is its slope, all as fractions of the stick's length.

Square root, and counting by multiplying

The square root of a number is what you multiply by itself to get it. The halfway point between two numbers counted by multiplying is the square root of their product.

Equipartition

The rule that, when particles keep bumping into each other, each way they can move ends up with the same share of the energy.

Zero-point motion

The jiggle of half a step that every motion keeps even at absolute zero, so nothing ever sits perfectly still.

A particle's clock and wavelength

Every particle ticks at a rate set by its mass, and its wavelength is how far light travels during one tick. The electron's is about 2.43 trillionths of a meter.

Error bar, sigma, σ

A measurement's give-or-take. A result within one error bar of a measurement is a good match, and five error bars off almost always means a real disagreement.

Femtometer, fm

A millionth of a billionth of a meter, the scale of a proton.

Newton's G

The constant that sets the strength of gravity, 6.674×10^{-11} in metric units. Two one-kilogram balls a meter apart pull on each other with that many newtons.

Coupling

A physicist's word for the strength of a grip between two things. α is the coupling of light to charge.

Observer, strength observer, tilt observer

An observer is anything that takes a measurement. A strength observer measures how much of something there is and drops the timing. A tilt observer, which this guide only imagines, would keep the timing too.

Hydrogen's second shell, 2s and 2p

The second energy level of the hydrogen atom, with four rooms at the same energy. The merge under Om happens there.

Lyman-alpha

The ultraviolet light hydrogen gives off when its electron drops from the second shell to the first, found by Theodore Lyman in 1906.

Maser

A microwave laser, in which every atom gives off its light in step with the others. Hydrogen masers are used as clocks.

Chakras, ida and pingala

The energy centers of yoga's map of the body, stacked up the spine, and the two side channels that wind around them and cross between them.

Royal cubit

The builders' unit at Giza, 0.5236 m, about the length of a forearm.

The drawing was made by a man who called himself J.C. at the 1996 *Dark Skies* premiere party, and Bryce Zabel and Brent Friedman host it as an open puzzle at soundlightfrequency.com. They suggested reading the equation's factors as sound, light and frequency, and the form of the equation is the author's. They don't claim the drawing has been scientifically validated, and neither does this guide.

Most of what is here is other people's work, and the credit is theirs. The square root at the equation's core goes back to H. S. Allen (1915) and Arthur Eddington, and Arnold Sommerfeld named α in 1916 for the fine structure of hydrogen. Hydrogen's second shell behaves as it does because of the hidden symmetry found by Wolfgang Pauli, Vladimir Fock and Valentine Bargmann. The proton-radius rule is Ole Trinhammer and Henrik Bohr's (2019). The central number 42.85 and the gravity relation are John Brandenburg's, restated with Salvatore Pais, whose Superforce appears in 5.3. Gravity from the vacuum's jiggle is Andrei Sakharov's idea, pursued by Harold Puthoff, and the polarizable vacuum is Robert Dicke's. The phase-and-scale picture of light and gravity runs through Hermann Weyl, Fritz London and Pharis Williams. Eric Weinstein's Geometric Unity places the ten dials of the sun's rays over every point and splits them six and four, and he has long argued for naming the people a result rests on, which this guide tries to do. Ralph Sansbury's *Faster Than Light* points at the factor of two in 4.4. The plasma picture, the insistence that no zero state exists, the attention to hydrogen's second shell and the picture of gravity as the medium's way of moving energy were prompted by the public notes of an anonymous engineer writing as @TMBSPACESHIPS. The equation itself does not appear in those notes, and every number in this guide is cited to published physics. The machine reading of the pyramid is Christopher Dunn's (*The Giza Power Plant*, 1998). The five-way split behind the 2/5 is standard physics (Landau and Lifshitz, *Statistical Physics*; Kadanoff and Martin, 1963), π/4 is Lord Rayleigh's (1880), the "almost" behind the tilt is Max Born and Robert Oppenheimer's (1927), the measurement form of the last step is John von Neumann's (1932), and the rule that light couples to charge and gravity to energy is Steven Weinberg's (1964). The chakra symbols are as described in the *Ṣaṭ-cakra-nirūpaṇa* (1577), translated by Arthur Avalon as *The Serpent Power* (1919).

Measurements: CODATA 2010, 2018 and 2022; Fan et al. 2023; Pohl et al. 2010; Antognini et al. 2013, re-evaluated 2024; Maisenbacher et al. 2026; Bullis et al. 2026; Burkert et al. 2023; Morel et al. 2020; Parker et al. 2018; Lange et al. 2021; Filzinger et al. 2023; Bagdonaite et al. 2013; Webb et al. 2011; DESI DR2, Planck 2018 and ACT DR6; Petrie 1883; Legon 1979; Lehner 1985 and 1997; Balezin et al. 2018. The full list, with every measurement compared, is in the paper.

This guide and the paper were written with AI assistance. Claude (Anthropic) was used to work through the physics, run the numbers, draft the text and build the figures. The idea, the reading of the drawing and the claims are Grant McCracken's, and so are any mistakes.

Grant McCracken, October 2026.