

# Why Does the Glove of Mathematics Fit the Hand of Physics So Well? On the Origin of the Fit

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## I. Introduction

Mathematics is the science of the most complete abstractions to which the human mind can attain. As such, it has inspired more philosophical questions about its foundations and its relation to the world than any other scientific discipline. The abstractions known as numbers are the backbone of science. If a subject cannot be described by numbers, it is not scientific. What, however, are these abstract entities known as numbers and why do they relate so well to the concrete physical sciences? Einstein's felicitous use of Bernhard Riemann's four-dimensional curved geometry and metric sphere to mathematically model his general theory of relativity is a stunning example of this enigmatic relationship. The glove of abstract mathematics existed for over half a century before the physical hand of the universe put it on, so to speak. Was mathematics also ready-made for quantum physics? Both the fine structure constant of hydrogen ( $1/137+$ )—the prime (first) element—and the  $1/137+$  probability of the electron jump are derived from Schrödinger's sovereign wave equation, which is derived from Euler's unique exponential growth function that nature had been wearing long before Euler discovered it. In recent years, Leibniz's and Euler's exponential growth (catenary) curve has also turned up in foundational cosmology mathematically modeling the inflationary growth of the newborn universe. Even the so-called "imaginary" number, the square root of minus one, has turned out to be "real." Vital and fundamental to both relativity theory and quantum mechanics, this unusual number is also essential to the dimensionless origin of dimensions and is equal to the speed of light for reasons that we will mention. All of these examples, plus many more, attest to the prescient nature of mathematics and what the philosopher-mathematician Gottfried Leibniz referred to as the "pre-established harmony" between mind and nature [1]. He based this idea on the (necklace) exponential growth function,  $y = e^x =$  the harmonic power series, which is unique in that it is the only exponential function (along with its constant multiples) that is its own derivative. As we will see, this unique function gives us a big clue regarding the fundamental symmetry or "pre-established harmony" of mathematics and the physical sciences.

That there is such a foundational connection between physics and mathematics is supported in part by the fact that when any two numbers taken at random are added together and then the latter number is divided by the former, the resulting numbers inevitably converge to a number very close to the fine structure constant of hydrogen ( $137+$ )— $137.5$  degree arc of a circle, the classic golden proportion. Significantly, this number also determines the possible histories of the electron of the hydrogen atom; the limit of the sum over the possible histories of the hydrogen electron is the golden proportion [2]. Is this connection between the angle of the golden ratio and the angular momentum of hydrogen in quantum mechanics just a coincidence, or does this connection go to the heart of both mathematics and the physical sciences? Because there is a necessary connection between relativity theory and quantum mechanics by means of the golden number  $137+$ —according to the astonishing formula,  $hc/2\pi e^2$  equals  $137+$ , where  $h$  stands for Planck's quantum constant,  $c$  stands for Einstein's constant of light, and  $e$  stands for the charge of the electron—I am going to contend that there is a necessary connection. What

appears to be a mere coincidence between the fine structure constant of 137+ and the 137.5 of the golden angle turns out to be an essential conjunction in terms of the exchange of photons (137+ of electromagnetism) at the atomic “vertices” or orbitals that are spaced by the packing ratio of the golden ratio just like the spacing of plant leaves in phyllotaxis.

Not only do any two numbers when collected (integrated) and divided (differentiated), as in calculus, converge to the golden ratio known as Phi, but all of the fundamental operations and operators of mathematics appear in Leonhard Euler’s identity, which physicist Richard Feynman referred to as “the most remarkable formula in mathematics” [3]:  $e$  to the power of Pi times  $i$  equals  $-1$  (which upon being seen makes one positively “Pi- $i$ -ed”). As Feynman himself discovered, when Phi is inserted into it, Euler’s formula becomes  $e$  to the power of Pi times  $i = 1/\text{Phi} - \text{Phi}$ . Correspondingly, the natural log  $e = 1.37^{\text{Pi}}$ ,  $\text{Phi}^{1.37} = \text{Pi}/\text{Phi}$ , and  $13.7^{1.37}/\text{Phi}^2 = 13.7$ , making a strong connection between another set of three fundamental constants. Furthermore, Leibniz, co-founder of calculus, showed that all numbers can be translated into the binary scale of zeros and ones, and, what Leibniz did not know, the binary code is based on Phi’s radical roots (the simplest nested radical) that oscillate back and forth between zero and one.

Leibniz rightly claimed “that all lines of motion in the whole of geometry are reduced to two motions only, one in a straight line and the other in a circle” [4], similar to the compression of all numbers to strings of zeros and ones. Beautifully, and amazingly, the line and the circle are the limiting cases of the golden Phi logarithmic spiral. A line is the minimum possible area, and a circle is the maximum possible area; all other polygons are intermediate combinations between these two figures. What Leibniz did not discover in both cases is that Phi is the unity-in-diversity that bridges the gap between these binary opposites. A one-dimensional straight line can be moved into a two-dimensional circle because of the joint arithmetic and geometric character of non-dual Phi. This (golden) intersection between dimensions is the result of the unique self-intersection of the dimensionless golden section with itself where infinity comes to rest.

Leibniz’s particular version of the law of continuity between dimensions (derivatives) and the corresponding relationship between the limit and the unlimited in a mathematical progression also depend upon Phi, since by multiplication and addition to a line a plane is produced; by multiplication and addition to a plane a solid is produced; etc. In the golden logarithmic spiral, the intervals add up while the ratio of frequencies multiply; this means that the radial angle adds up in an arithmetic progression at the same time that the spiral radius grows up in a geometric expansion. Together these two progressions produce the harmonic progression of all the subsequently derived dimensions. These two progressions come right out of Descartes’s equiangular spiral of analytic geometry, the “giant” inspiring (spiral) forerunner of Leibniz’s and Newton’s calculus. Phi is the only proportion that remains the same or true to itself by both adding and multiplying itself, which makes it the portal or “black (Fibonacci rabbit) hole” connecting one dimension to another, the common boundary/coupling constant between linear and non-linear expansion, order and chaos, the limit and the unlimited. In short, it is the binary switch between dimensions.

## II. The digital universe

Leibniz's further translation of the decimal code into the binary system also shows a deep correlation between unity (ones) and the progression of 1, 3, 7 that consistently appears whenever we apply the block (142857) and period (132645) of the special number seven, the smallest number which when divided into unity makes a period of recurring digits:

Decimal	Binary	Decimal	Binary
1 = 2 <sup>0</sup>	= 1 = 0 x 7 + 1	17 =	10001
2 = 2 <sup>1</sup>	= 10 = 1 x 7 + 3	18 =	10010
3	= 11	19 =	10011
4 = 2 <sup>2</sup>	= 100 = 14 x 7 + 2	20 =	10100
5	= 101	21 =	10101
6	= 110	22 =	10110
7	= 111	23 =	10111
8 = 2 <sup>3</sup>	= 1000 = 142 x 7 + 6	24 =	11000
9	= 1001	25 =	11001
10	= 1010	26 =	11010
11	= 1011	27 =	11011
12	= 1100	28 =	11100
13	= 1101	29 =	11101
14	= 1110	30 =	11110
15	= 1111	31 =	11111
16 = 2 <sup>4</sup>	= 10000 = 1428 x 7 + 4	32 = 2 <sup>5</sup>	= 100000 = 14285 x 7 + 5

Etc.

(Does the reader see how all the above strings of binary ones are produced because of the 1, 3, 7 progression? If not, count the numbers in between all of the binary numbers that have only ones in them. This progression provides us with a deep clue as to the unity [ones] of the binary number code.)

Here are the block and period of the prime number seven that generates this 1, 3, 7 series:

Block	Period (of digits in the last column)
3 x 7 = 21	
2 x 7 = 14	
6 x 7 = 42	
4 x 7 = 28	
5 x 7 = 35	
1 x 7 = 7	

In brief, all numbers can be digitally reduced to sums of the powers of two, and all digital numbers can be compressed to a set of ones through the block and period of the number seven and the Phi progression of 1, 3, 7. One number is all—all numbers are one. Leibniz also knew that this same progression appears whenever solutions to the simple binary formula  $2^n - 1$  are

found:  $2^0 - 1 = 0$ ,  $2^1 - 1 = 1$ ,  $2^2 - 1 = 3$ ,  $2^3 - 1 = 7$ , etc., all these numbers being one less than a power of two. (The number two and its powers appear more often in mathematics and physics than any other numbers.) This formula is, for Leibniz, one of the reasons why there is something rather than nothing, i.e., a reason for the origin of things; it is like the law of least action—how easily something comes from nothing—that Leibniz also discovered. The shortest “distance” between nothing and something (zero and one), which are the first two numbers of the Fibonacci number sequence, is the least amount of action (energy times time), like the pure dimensionless number 137+. What Leibniz did not know is that the golden proportion, as mentioned above, is also the link between nothing and something in terms of the (quantum) jump from one dimension to another that thereby relates Phi to the quantum of stationary action (137+). Something is easier than nothing; a complete vacuum is difficult to sustain. “[The golden ratio] is a scale of proportions which makes the bad difficult and the good easy,” said Einstein [5].

There is quite stunningly yet another well-known connection with prime numbers, which are the so-called “building blocks” of mathematics: if and only if  $2^n - 1$  divides the  $(n - 1)$ th term of a series, then  $2^n - 1$  is prime; otherwise, it is composite. Almost magically, the Mersenne sequence of primes, according to  $M_p = 2^p - 1$ , also produces the progression of 1, 3, 7 that figures prominently in the binary and decimal number systems. Moreover, prime numbers, the “atoms” of mathematics, are necessarily related to the atoms of nature because of the well-known Rydberg rule that follows the same pattern as Euler’s harmonic zeta power series (derived from the self-derived exponential growth function):  $Zeta(x) = 1/1^x + 1/2^x + 1/3^x + 1/4^x + 1/5^x \dots = \pi^2/6$ ; which is the inverse of the probability that any two numbers selected at random will be prime to one another. As mentioned earlier, Schrödinger’s wavefunction that revealed the fine structure constant or “barcode” of hydrogen (137+) is also derived from Leibniz’s and Euler’s exponential growth function known as the harmonic power series. The exponential function is the simplest possible differential equation, the unique solution to  $dy/dx = y$ ;  $y(0) = 1$ , and the most primitive derivative in which state and rate, the integral and the derivative, the evolute and the involute, and the squaring of a root and the extraction of a root are the same. It bears repeating that this function (and its constant multiples) is the only function like this.

There is, of course, an intimate connection between primes and the natural logarithm through the prime number theorem, except that in order for the exponential growth function to use the natural log of 2.718, the first factorial in the series  $1/0!$ , like the second factorial  $1/1!$ , has to equal one. Otherwise, the sum of the series is only 1.718. But how can this *indeterminate* expression be equivalent to a *determinate* unity without introducing an *ad hoc* factor at the beginning of the factorials to finesse the gap? The answer is to be found in the *indeterminacy* of quantum mechanics. There has to be a quantum jump (a Fibonacci energizer bunny hop!) that bridges the gap between the indeterminate beginning and the subsequent definite series, and that is the dimensionless number 137+, or Planck’s constant, which is the basis of the quantum principle of indeterminate determinacy. The Planck bridge has gaps between its planks, which is why it can join indeterminate zero (nothing) with determinate one (something)! Newton’s and Leibniz’s calculus, exponential function and binomial theorem all depend upon this initial leap from nothing to something, the *alpha* number that explains why there is something rather than nothing. This spark gap is what breathes life into the *natural* log and enables it to *grow*. It’s the fire in the exponential equation that enables the universe to explode, inflate or grow! As our bubble inflates it cools down, producing the Cosmic Background Radiation that has a dampened

oscillation in accordance with the harmonic series of the natural logarithm [6]. The  $1/0!$  factorial at the beginning of the series equals the number one because of the bridge of stationary action of  $137+$ , just as the fundamental constants equal one, as we will see, because of *alpha*  $137+$ . “There is a deep connection between the symmetry principles and the conservation laws, but that connection requires that the minimum principle [of least action] be assumed.... In the last analysis the connection of symmetry laws to conservation laws comes from quantum mechanics,” wrote Feynman [7]. In light of all these unique connections and characteristics *alpha* is the basis or boundary condition of the “pre-established harmony” at the prime “atomic” level of mathematics, physics, and cosmology. For the essences of things are numbers, especially primes. Without prime numbers as foundational building blocks and their cornerstone, the “prime” prime  $137+$ , mathematics and physics would crumble.

Furthermore, without calculus physics is incomplete, if not useless. Without the natural log calculus is incomplete. Without the original *alpha*, *i*, *h*, or Phi “Fibonacci energizer bunny” the natural log is incomplete. Phi is complete because it is its own derivative, its own unity of zero and one (like its Greek symbol  $\phi$ ) in a state of superposition, out of which derivatives like position and motion in calculus emerge. Like Leibniz, Einstein wondered whether a God had any choice in making the universe. Did a God choose this universe because of its harmony, or is there harmony because a God chose it? In a quantum, self-referential, participatory universe, this question is based upon a false disjunction. Because of superposition and quantum logic (the logic of “both-and”), the two are not mutually exclusive. This universe was “selected” because of its pre-established harmony, but the harmony presupposes the self-referential Phi, etc., in the beginning, or else the harmony is incomplete. So, yes, there was a choice amongst possible universes because of the original indeterminacy in the pre-established harmony. But, no, there was no choice because the harmony is so beautiful. Both diversity (freedom) and unity (harmony) are present together in Phi, *i*, *h*, and *c*, like the golden mid-section between two sides of the same coin. Light (*c* or  $137+$ ), like everything in the universe, always follows the path of the beautiful, and beauty is in the Phi of the beholder, which means that beauty is both invented and discovered. Like all great equations, proofs, and physical theories, beauty is both surprising and inevitable.

Since even the prime number “building blocks” of mathematics are grounded in the decimal system, and the decimal system is rooted in the 1, 3, 7 progression, there has to be an intimate connection between primes and these three numbers. And indeed there is: the place marker in the Fibonacci sequence of a Fibonacci number is a prime number. Such in part is the “dicemal” code of the prime numbers. (The English word “dice” comes from “dike,” in Greek, which means “justice,” as in the title of Leibniz’s only book published in his lifetime, *Theodice*, “the Dice of God” [8]). The primes are being justified or put to “rights,” as was first conjectured by Gauss using the prime number theorem and then hypothesized by Riemann in terms of the harmonic zeta function that is the “pre-established harmony” between primes and the non-trivial zeta zeros. A bridge between the primes and the number  $137+$  is an integral part of my published proof of the Riemann Hypothesis (see biography).

### III. Why 137? (According to physicist Max Born, "... the number 137 is the dominating factor of all natural phenomena" [9].)

As mentioned earlier, 137+ is the dimensionless number not only of hydrogen but of Einstein's constant of light, Planck's constant of action, and Feynman's charge of the electron, according to the quantum mechanical relativistic formula,  $hc/2\pi e^2$ , known as *alpha*, the first letter of the Greek *alpha*-bet. Moreover, significantly, this number is the basis of Newton's constant of gravity, Boltzmann's constant of temperature in thermodynamics, Boltzmann-Maxwell's parameter of gas, and Coulomb's constant force of the atom whenever Max Planck's natural units are used to take the measurement of mass ( $M$ ), length ( $L$ ), time ( $T$ ) and temperature ( $J$ ). All of these major fundamental constants in nature equal the number one (!), using these natural units, because the elementary charge of the electron or proton equals the square root of 137+ [10]. So,  $alpha = G = h = c = k = epsilon_0 = 1$ , when  $e =$  the square root of 137+, making 137+ the number one (1) number. When all of these constants except one of them equals one, the remaining one has to equal 137+. What's it all about, Alfie? It's all about *alpha* or "all-phi" (137+). This special ratio is the only way in which all of these constants can be combined into a unity, which goes a long way toward explaining "the unreasonable effectiveness of mathematics in relation to the physical sciences" [11]. "Planck's units are the only combinations of these constants which can be formed with the dimensions of mass, length, time and temperature" [12]. Size 137+ is the perfect fit between hand and glove; one size (glove) fits all.

Quite remarkably, according to a paper by Radu Coldea of Oxford University published in January, 2010, when the spins of superchilled cobalt niobate crystals were precisely magnetized into a state of quantum uncertainty, a fractal pattern appeared in which the interaction between spins made a series (scale) of resonant notes--the relationship between the first two notes being the golden ratio of 1.618! Coldea is convinced that the presence of the golden proportion is not an accident. "It reflects a beautiful property of the quantum system—a hidden symmetry. Actually quite a special one called E8 by mathematicians, and this is its first observation in a material [medium]" [13].

Another "exotic" relationship between mathematics and physics can be seen in the equivalence between light-speed (137+) and the so-called "imaginary" square root of minus one:  $E = mc^2$ . Since  $c^2$  is -1 seconds,  $c$  itself equals the square root of -1. Leibniz referred to this unusual "number" as the "amphibian between nothing and something" [14]; he might just as well have said that it is the "am-Phi-bian" between them because this special equation of special relativity changes one dimension into another (time into space) just as does the golden proportion because of Phi's uniquely combined arithmetical (additive) and geometrical (multiplicative) property. Just as the two 137s appear in hydrogen and in quantum uncertainty, they also appear as the conversion transformation of one dimension into another. Consistent with this transdimensionality, a wavicle of light, like Phi, is both a whole and a part, a line and a point. At the speed of light, almost miraculously, an object becomes a cross-section of itself. If the first dimension is a cross-section of the second, and the second is a cross-section of the third, etc., what, we may ask, is the zero dimension (null line of light)? The answer is that it is its own cross-section, just as Phi is a cross-section of itself. In a word, both light and Phi are self-contained, like a fractal. It also happens that the number of rays of light reflected through a medium, after having been absorbed in it, are all Fibonacci numbers that converge to Phi.

Because of *alpha*, light, like hydrogen, is related to both 137s. Since *i* cannot have any roots, it too is its own cross-section or a 90-degree angle between horizontal and vertical lines, one dimension and another. (Remember: the cosine of a 90-degree angle is zero.) Just as the rotation of the 90-degree angle twists the two forces of electricity and magnetism into one force (Maxwell's electromagnetism), like the Möbius strip, so does it combine line and plane, time and space, position and momentum, etc., into unities. One dimension is at a right angle to another, time is at a right angle to space, and position is at a right angle to momentum.

In the beginning was *alpha*, out of which leaped hydrogen, the first element, along with light (*c*), heat (*k*), and gravity (*G*), the first of the four fundamental forces, like a white (Fibonacci) rabbit out of a black hat (rabbit hole). According to the *alpha* equation, the very small (Planck's quantum constant) and the very large (Einstein's constant of relativity) are neatly conjoined through the mediation of the electron charge, which is the square root of 137+. It's even the case that a rotating black (rabbit) hole, as discovered by Paul Davies, flips from a negative to a positive specific heat when the square of its mass divided by the square of its spin parameter is equal to the golden ratio [15].

*Alpha* 137 is not only present at the beginning of the universe, it is present throughout its entirety, from top to bottom. When 137+ is combined with two other fundamental constants, 1/1836, which is the ratio of the electron-to-proton mass, and Newton's gravitational constant, these three constants scale (ration) the sizes of everything in the universe from the smallest subatomic particles to the largest super-superclusters of galaxies. The whole universe is "graded" on the logarithmic growth curve, and it passes the "Goldilocks" test. "Any percent or so change one way in [*alpha*] will cause all stars to be red stars; and a comparable change the other way will make all stars be blue stars... In neither case will any star like the sun be possible... Man could never come into being in such a universe," writes John Wheeler [16].

#### **IV. Conclusion: a uni-Phi-ed theory (the tau) of mathematics**

According to well-tested quantum theory, light and matter are both particles and waves, or superposed wavicles, which, for Richard Feynman, are the "general mystery" of quantum physics [17]. It was Einstein's happy discovery that these two characteristics of light are bridged by Planck's constant of action. Since this discovery is so fundamental to quantum mechanics, it cannot be highlighted enough: without Planck's constant that combines particles and waves, momentum and position, energy and time, and many other conjugate pairs as well, quantum physics would collapse like a house of cards. (Planck's constant is the most ubiquitous number in quantum mechanics.) And what is the number/ratio of light and Planck's constant that lies at the basis of all objects, not to mention that of the first element and its quantum electronic history pathways? It is, of course, Feynman's "mystery number" 137+ that "all good theoretical physicists put up on their wall and worry about" [18]. At this very point, the wall between theory and fact, the rational and the empirical, mathematics and physics breaks down. Speculation and experiment become superposed; the same point that produces one produces the other. This means that the measure and the measured are not separate from each other. There is simply "bootstrap" self-referral self-measurement, self-action, self-intersection, self-derivation, self-representation, and self-containment—all of which are 137+. Measure without the measured is empty; the measured without the measure is blind. We know that we

have reached a fundamental rock-bottom level whenever ostensible opposites become merged into an irreducible self-derived, self-encroaching, self-supporting unity like Phi, wavicles, stationary action, spacetime, quanta of light, etc. No further differentials can be calculated, e.g., the difference between the product of position and momentum cannot be less than Planck's constant of  $137+$ , and the self-derived golden ratio cannot be further reduced. Extracting square roots through calculus enables us to arrive at the square root of all roots, the root (origin) of all things or first principle, and put everything to "rights." This is as far down as the Fibonacci rabbit-hole goes.

This number is not only the lowest common denominator or coupling constant between math and physics, it also links chemistry to biology since both begin with hydrogen. Hydrogen bonds join together and shape the (top down) golden decagonal (digital) double helix form of DNA, as do the similarly supportive hydrogen bonds of water, the one non-negotiable prerequisite for life. If everything in the universe boils down to hydrogen and its quantum dualities, and all of these dualities boil down to a single constant, and everything is a combination of waves and particles based upon this same single constant, plus, this constant cannot be boiled down any further since it is self-derived and self-differentiated, what else can this dimensionless number/ratio be? The differences among the differences have all been calculated down to zero in the golden number. Phi's the limit. Werner Heisenberg once remarked that when this special number/ratio of hydrogen is understood the mysteries of physics will "shrivel up" [19]. The Nobel physicist Victor Weisskopf is supposed to have remarked, "When hydrogen is understood, we will understand all of physics." When asked if he really said this, he replied, "No, but I wish I had" [20]. Since the pure golden number/ratio is both the deepest depth and has the widest span of inclusion in nature through the constants of light (the "large") and stationary action (the "small"), as well as in the scale in between, it has enormous explanatory power. "A theory is more impressive the greater is the simplicity of its premise, the more different are the kinds of things it relates, and the more extended its range of applicability," Albert Einstein wrote [21].

Moreover, the golden ratio is the only section that is created out of the self-interaction of the number *one* (the simplest continued fraction and the simplest nested or "radical" radical), the only number that is its own reciprocal when the number *one* is added to or subtracted from it ( $1.618 = .618 + 1$ ), the only number and its reciprocal whose multiplication and difference are both equal to *one*, and the only number that is *one* less than its square. As if this were not enough, Phi is the most irrational of all the irrational numbers, the only division in which the "parts" remain one whole even in their separation, the only division that is a two-term proportion, the only proportion in which the addition and the multiplication of itself are equivalent, and, most significant of all, the only number that any two numbers converge to, all numbers, without exception, being the result of putting together powers of the golden section. Because they are pure, fundamental, dimensionless numbers or ratios, both Planck's constant of action ( $137+$ ) and the golden proportion ( $137.5$ ), like the square root of minus one, are the connecting links between all the dimensions in mathematics and all the derivatives in physics and also help explain why there is something rather than nothing. To find an explanation is to find the middle term between one thing and another. In mathematics and physics the middle terms are  $137+$  and Phi which are self-explanatory and self-justifying because they are self-derived.



To sum it all up (to the limit):  $\alpha$  equals  $137+ = i = h = c = k = G = e^2 = \epsilon_0$ .

So, why does the glove of mathematics fit the hand of physics so well? It is because all of the glove's numbers, following the Fibonacci progression, converge to the golden section, and all the elements of physics and chemistry are based upon the prime element of hydrogen whose "fingers" or "digits" (the quantum histories) follow the Fibonacci progression toward the same golden ratio. Indeed, the segments of the fingers and hand all expand like a telescope in accord with the Fibonacci numbers so that when we make a fist the golden logarithmic spiral surprisingly appears. This is the (pure) gold standard, their original fit, the pre-established "arrival of the fit." Furthermore, as we saw earlier, the digital decimal code shares the same number of digits as the hands do, and the conversion of the digital code to the simple binary system sequentially follows the progression 1, 3, 7, etc., using the smallest, simplest, most fundamental cyclic number fraction, one divided by seven (seven is the "virgin number" because it has no divisors and gives birth to itself). The consistent simplicity and simple consistency amongst all of these fundamental numbers, constants, and codes are no accident. Their congeniality and symmetry are the result of a common gene, the number 137, which because of its unusual uniqueness and self-referral irreducibility is the origin and foundation of both mathematics and the physical sciences.

In the beginning was the word, and the word was *Alpha*.

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