Discovery Of The Solution To The Fibonacci Sequence Of The Fine Structure Constant 137

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Abstract: The fine structure constant α is a dimensionless number approximately equal to 1/137. Its reciprocal 1/α is approximately equal to 137, not a whole number. Research results in recent years suggest that it may vary in the large-scale space-time range of the universe, and may also be anisotropic and have a specific direction preference. In the analysis of the 137 value, the Author found that it contains the information structure of the Fibonacci sequence, and the Fibonacci sequence is inseparable from the golden ratio, fractal geometry, etc., and is an important law in nature. This may suggest that whether the fine structure constant may vary in the universe, or its objective measurements show that 1/α is only a decimal close to the integer of 137. 1/α is likely to be approaching to this integer due to certain mechanism related to the integer 137, while the core around it is still the integer 137, but there are some effects or disturbances in the measurements, including errors, possible universe anisotropy, and the brokenness of the universe itself, that causes the numerical result deviates from the integer slightly. The exact expression of 137 by the Fibonacci sequence is given here; in addition, an attempt is also made to give a formula of α that includes the value of the golden ratio, and the approximated expression of the formula.

Key words: Fine structure constant; 137; Fibonacci sequence; Golden ratio; Expression; Approximation formula

Fine structure refers to the fine structure patterns produced by the splitting of atomic spectral lines due to electromagnetic interactions in atomic physics. The fine structure constant is usually represented by the Greek letter α, with the calculation formula $\alpha=e^2/(4\pi\varepsilon_0 c\hbar)$ Or $\alpha=e^2/(2\varepsilon_0 ch)$, where e is the charge of the electron, ε_0 is the vacuum permittivity, ħ is the reduced Planck's constant, c is the speed of light in vacuum, and h is Planck's constant[1]. Because the units of the constants in the calculation of the formula just cancel each other, so α is a dimensionless number, that is, a pure number, without a unit, or the unit is 1. More precise calculations and experimental measurements now show that $\alpha \approx 0.0072973525\,6$, which is very close to 1/137. Its reciprocal $1/\alpha \approx 137$ (more approximately 137.035999206) is also commonly used as an approximation for the fine structure constant[4].

α Has many physical meanings, such as it represents the ratio of the linear velocity of the electron in the first Bohr orbit to the speed of light in vacuum, it also represents the ratio of the classical radius of the electron to the Compton wavelength, and the ration of the Compton wavelength of the electron to the orbital radius of ground-state electron, and the ratio of the ratio of electrostatic interaction energy of two electrons separated by the Compton wavelength to the static energy of one electron, etc[2]. From this we can see how important α is to the atomic structure. But why α is approximately equal to 1/137, and its reciprocal is almost equal to 137, which is called the Mysteries of 137. Since the last century, it has attracted many physicists and mathematicians that have assiduously been trying to use various methods to deduce the value of the fine structure constant, or proving that it is equal to the

integer 137, but there is no convincing result so far. Famous scientists such as Austrian American physicist Pauli were once obsessed with this. Pauli was later hospitalized due to illness and had a premonition of the end of his life when he saw that the room number was exactly 137. He passed away in this ward a few days later. British astronomer and physicist Arthur Eddington initially attempted to use purely logical methods to prove that the reciprocal of the fine structure constant $1/\alpha = (16^2 - 16)/2 + 16 = 136$, was consistent with experimental results at the time. Later, more precise experimental measurements showed that $1/\alpha$ was closer to 137, which prompted him to check the original calculation process, who claimed that there was a small error; after correction, $1/\alpha$ was equal to integer 137. This led him to insist that the reciprocal of the fine structure constant was the integer 137[3]. There are many other calculation formulas, the following are a few examples:

$$\alpha = [1 - 1/(30 \times 127)]/137 \approx 0.00729735426$$

$$\alpha = \cos(\pi/137)/137 \approx 0.00729735101$$

$$\alpha = 29\cos(\pi/137)\tan[\pi/(29 \times 137)]/\pi \approx 0.00729735253$$

Later on, more precise experimental data showed that $1/\alpha$ was indeed very close to 137, but not an integer. Although the above calculation results are very close to the real value, they are all the same as Eddington's calculations, which were rejected as they both lacked any theoretical basis to support and were distanced by the ever-improving test accuracy[3].

Richard Feynman, the famous physicist, once said: "It has been a mystery ever since it was discovered more than fifty years ago, And all good theoretical physicists put this number up on their wall and worry about it... It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the 'hand of God' wrote that number, and 'we don't know how He pushed his pencil.' "[3]

Through numerical analysis of integer 137, the Author found that it has a factor of decomposition of the Fibonacci sequence, which can be written as the following formula:

$$\left\{\left[\left(\left\langle\left\lfloor 0\times 2+1\right\rfloor\times 2+2\right\rangle\times 2+3\right)\times 2+5\right]\times 2+8\right\}\times 2+13=137$$

This formula can also be written in the following form:

$$2^5\times 1+2^4\times 2+2^3\times 3+2^2\times 5+2^1\times 8+2^0\times 13=137$$

That is, the following formula:

$$32\times 1+16\times 2+8\times 3+4\times 5+2\times 8+1\times 13=137$$

The six numbers marked by the underline are 1, 2, 3, 5, 8, 13, which are in the famous Fibonacci sequence of 1, 1, 2, 3, 5, 8, 13, 21, 34, 55… , Just the leading terms excluding the first repeated one. 32, 16, 8, 4, 2, And 1 are the reverse order of the first six terms of the 2-time geometric progression starting with 1.

The last two equations above can be summarized in tabular form as follows:

Geometric progression and its exponential form	2^5	2^4	2^3	2^2	2^1	2^0
	32	16	8	4	2	1
Fibonacci sequence	1	2	3	5	8	13
Product of two corresponding terms	32	32	24	20	16	13
Sum of products	137					

The reason why many physicists think that the fine structure constant may be explained in some way is probably because of the importance of its multiple physical meanings, and the fact that its reciprocal value is so precise and specific that it seems to be devised around

integer 137. Moreover, number 137 is not too small, it is so common as it is in the category of numbers that often links with people's experience.

And through the Author's analysis of number 137 above, we can see that it can be neatly and perfectly expressed by the sum of the products of multiplication of the Fibonacci sequence and the corresponding terms of the double-fold geometric progression sequence. The Fibonacci sequence often appears in various natural things, such as in the number law of plant petals and branch growth and bifurcation, in the family tree structure of bees, in the quasi-periodic law of quasi-crystal atomic arrangement, and so on. The Fibonacci sequence is also known as the golden ratio sequence, in which, the ratio of the adjacent two terms of the sequence is getting closer and closer to 0.61803398… , While the reverse (reciprocal) is 1.61803398… , In this respect it actually expresses the golden ration in the form of a sequence. The golden ratio also frequently appears in natural things, which corresponds to the frequent appearance of the Fibonacci sequence in natural things. The ratio of the small part to the large part of the golden ratio is equal to the ratio of the large part to the whole, which is obviously a fractal principle, and fractals also exist widely in nature. According to the Fibonacci sequence, a spiral can also be constructed, which is called the Fibonacci spiral. The movement of all things in the universe changes by choice of or with the tendency of such spiral pattern, such as spiral galaxies, typhoon cyclone, and snail shell spirals, etc. The Fibonacci sequence, the golden ratio, fractals, and Fibonacci spirals represent some important laws of nature. The latter three are hidden in the former, i.e. the Fibonacci sequence. Number 137 can be perfectly expressed by Fibonacci sequence and double-fold geometric progression sequence, or it contains Fibonacci sequence and the proportional factor of the double-fold geometric progression sequence; then only due to the fact that number 137 contains Fibonacci sequence information, it can just be associated with the golden ratio, fractals, and Fibonacci spirals. In the sense of physics, number 137 itself is a basic constant that describes the laws of particle motion and interaction. If the theoretical or data support for the Fibonacci sequence and the other three connotations (the golden ratio, etc.) contained by the Fibonacci sequence can be found from the number, then it can be proved from this perspective that the prototype of the fine structure constant may be integer 137. What's more, from the first Fibonacci interpretation of number 137 above, it can be seen that information of the Fibonacci sequence contained in the number 137 has a structure of layered nesting and layer-on-layer expansion, which is consistent with the golden ratio, fractal., Fibonacci spiral and Fibonacci sequence, and also have a high degree of similarity with the atomic structure.

But after all, the exact value of the fine structure constant is not an integer. If its prototype is the integer 137, this requires further explanation. Modern science has revealed that the real world is fractal to a high degree, which is the result of the synthesis of various nonlinear systems, and there is brokenness in the symmetry instead of perfect symmetry and conformity to strict deterministic linear rules. So many things show complexity and irregularity. Imperfections, brokenness of symmetry, and elusive variation may be more the essence of the universe, although our scientific system has always striven to be based on summarizing, abstracting, and standardizing the laws of the universe. The golden ratio is still a good example here. The definition of the golden ratio contains the meaning of fractal, as mentioned above. The golden ratio of things can be said to be a fractal structure. Extensive

calculations in scientific research have found that most of the one-dimensional fractal dimensions in nature are concentrated around 1.6-1.7, which are actually moving towards the golden ratio of 1.61803398… Closer enough as it is, but it is difficult to be strictly equal. There are many golden ratios in the human body structure, which are also approximate values only. Other things in nature with the golden ratio are basically in the same manner. As it can be seen here, the exact value of the golden ratio is 0.61803398… And 1.61803398… , It is an extreme value, an ideal value, or a standard value, but the real world is complex, broken, and imperfect, allowable of variations from commonness, so things with the golden ratio cannot always be strictly equal to the golden ratio, but exist deviations of varying degrees. Or we can say that, the golden ratio in natural things is not strictly equal to its exact value, but the ideotype is the exact value. Then the fine structure constant is also likely to be similar, that is, its exact value is not the integer 137, but its ideotype is the integer 137; due to the nature of imperfection and brokenness of the real world, its exact value deviates slightly from integer 137, which becomes 137.035999206… . Of course, the deviation from the theoretical ideotype value to the actual value may also be due to some effects or disturbances, including measurement errors and possible cosmic anisotropy and other comprehensive factors. Anyhow, this requires theoretical confirmation and experimental verification for particle physics.

Using the above derivation method for the integer 137, a rather special sequence containing 137 can also be obtained, namely 0, 1, 4, 11, 27, 62, 137, 295, 624, 1303, 2695… . The numbers in this sequence undoubtedly have information factors such as Fibonacci sequence, and they grow rapidly forwardly. In addition to the possible unique meaning of 137, the number 62 adjacent to it is also the total number of elementary particles discovered so far, which is really interesting due to such a coincidence. There are other connotations of this sequence, which are beyond the scope of this article, and are temporarily unavailable.

Regarding the fine structure constant α (including the integer 137), the Fibonacci sequence and the golden ratio, in addition to the above, the Author also found a relatively concise formula for approximate calculation of α, as follows:

$$\alpha = \left[1-(\phi/100)^2\right]/137 \approx 0.0072973590992$$

(Where φ=1.61803398… , The same below)

Replacing 137 in the formula with the sum of the products of the Fibonacci sequence and double-fold geometric progression sequence can be written as:

$$\alpha = \left[1-(\phi/100)^2\right]/(32\times1+16\times2+8\times3+4\times5+2\times8+1\times13) \approx 0.0072973590992$$

The association of the integer 137 with the Fibonacci sequence, the golden ratio, etc., and the conjecture that it may be the ideotype of the fine structure constant, if confirmed by theoretical physics and experiments, will have great implications for particle physics and cosmology. Now, with the ingeniousness and wonderfulness of the layer-on-layer nested structure formed by the intersection of the Fibonacci sequence and the double-fold sequence, it displays the shocking beauty of mathematics, logic and philosophic interest. In addition, due to the physical meaning of the fine structure constant and the possibility of intersection among the natural laws such as the Fibonacci sequence, the golden ratio, fractals, and Fibonacci spirals, we are full of expectations for this conjecture.

References

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