Uncover the logic of Fine Structure constant

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In this paper, author introduced two theories, energy spiral as a unified field and dual resonance for energy transfer. This paper is based on these theories. Through studying formation process of particles, as was indicated that: vacuum particles and 12 basic particles are existing in the vacuum, which will become protons or electrons. In the hydrogen atomic, the external vacuum energy affects on the energy spiral of the electron, then revolution energy and rotation energy of the electron are determined, finally the parameters of Bohr structure are determined. And logical value of Fine Structure constant is obtained. [$\alpha = \sqrt[4]{2}\pi/512$]. This data is supported by the calculation results of experimental data.

Usage: Quantum mechanics, field theories, special revativity.

keywords: Fine Structure constant, Unified-Field theory, Energy Spiral, Vacuum energy, Energy fusion, Bohr orbit, Rydberg constant, electron mass

Fine Structure constant is a fixed constant, which was defined as the ratio of the velocity of electron in hydrogen atom to the speed of light in Vacuum as equation (1). Many famous scientists were obsessed with why it was so, and called it "Number of God". To solve this problem, we need to expand the current physical theory. Author introduces energy spiral field as unified field into Grand Unified theory, which is used through all of this paper. In order to realize pure logic calculation, author uses only symbols and does not use data during the deducing process. The actual physical data is used only during the final validation process.

$$\alpha = v/c \tag{1}$$

I. GRAND UNIFIED THEORY

Grand Unified theory considers that everything is vibration. With Mass energy equation and Plank's quantum energy formula, we can convert mass or energy as vibration wave into frequency or wavelength to calculate. When interacting, energies are vectors.

$$E = mc^2 \tag{2}$$

$$E = h\nu = hc/\lambda \tag{3}$$

Two energies E_1 and E_2 effect to compound energy E, always with a smallest interact model. $E_1 = n_1 E_{01},\ E_2 = n_2 E_{02}$. To different smallest energies E_{01} and E_{02}, there are different interact models and different coefficients.

$$E = f(E_{01}, E_{02})\frac{n_1 n_2}{r} = \frac{f(E_{01}, E_{02})}{r}\frac{m_1}{m_{01}}\frac{m_2}{m_{02}} \tag{4}$$

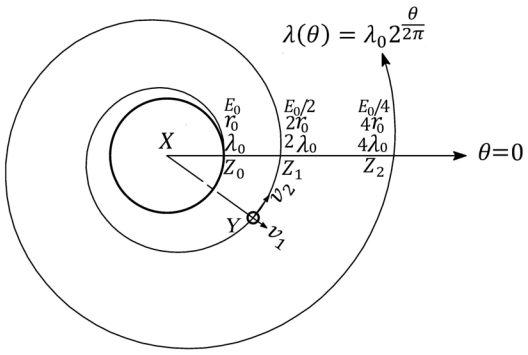

FIG. 1. Energy Spiral

A. Energy Spiral–Unified-Field

Energy spirals are all over the world. To describe the energy spirals, let's assume a case as figure 1: Micro-particles "Y" are at the surface of object "X". Under some influence from "X" or some external influence, micro-particles "Y" get critical energy E_0, usually at specific position "Z_0"$(E_0, 0)$ of the maximum rotating surface of object "X", they move outwards around "X" one by one. $E_0 + E_{p0} = 0$, E_{p0} is the potential energy. To remain the relationship with "Z_0", "Y" moves towards the first resonance point "Z_1"$(E_0/2, 2\pi)$ after one circle of motion, then moves forward to the next resonance point. $E + E_p = 0$ at any time during moving process. $E = hc/\lambda$, equation (4) can be simplified to $E_p = -k/r$. To meet the shortest path of energy, v_1/v_2 is constant, forms th path as a logarithmic spiral. As fingure 1, v_1 is the radial velocity, and v_2 is circumference velocity. Many micro-particles "Y" are moving in this path, and form a energy spiral field. Get the equation of energy spiral in polar coordinate as follow:

$$\begin{aligned}&\{E + E_p = 0,\ E = hc/\lambda,\ E_p = -k/r\} \Rightarrow hc/\lambda = k/r\\ &\{(E_0, 0) \to (E_0/2, 2\pi)\} \Leftrightarrow \{(\lambda_0, 0) \to (2\lambda_0, 2\pi)\} \Leftrightarrow\\ &\{(r_0, 0) \to (2r_0, 2\pi)\} \qquad \because v_1/v_2 \textit{ is constant} \therefore\\ &\qquad r = r_0 2^{\theta/2\pi} \Leftrightarrow \lambda = \lambda_0 2^{\theta/2\pi}\end{aligned} \tag{5}$$

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As we can see from the equation (5): All of energy spirals are same in graph, and everything can be unified with energy spirals. The directions of the energies are expressed as azimuth angles on the energy spiral.

B. Dual Resonance 2^n–Energy transfer beyond distance

As we can see from the equation (5): Any energy wave λ can resonate the matter at the point λ of any energy spiral, and continues to transfer the energy to next resonance point of the energy spiral along the line of polar radius, finally radiate to any resonant point $2^n\lambda$ of the energy spiral (n is an integer). So λ and $2^n\lambda$ can transfer energy each other, and λ can affect as $2^n\lambda$. It is important. Many natural phenomena are based on this principle.

$$\lambda \Leftrightarrow 2^n\lambda \quad or \quad \lambda \Leftrightarrow \lambda/2^n \tag{6}$$

Energy Spiral Field theory is an ancient theory which was used in Newton color ring and music theory and others. Energy spirals are hard to detect, but equivalent ratio 2^n are common in the nature, such as the sunspot cycle, the revolution radius of planets in solar system.

II. FORMATION OF ELECTRONS

Vacuum is the base of nature, and everything is in the vacuum. From some physical phenomenon, author deduced that vacuum is full of vacuum particles with the energy $E_v = hc/\lambda_v$. Vacuum energy is the primal energy in nature to create all energies, and vacuum particles are the primal unit of the matters. How do vacuum particles evolve into new particles?

Several vacuum particles gather into a group as a new particle with energy $E = jE_v = hc/\lambda'$, $\lambda' = \lambda_v/j$. When the wave λ' affects on these particles, it will be absorbed and generate a new wave λ''. If energy $[E = jE_v = hc/\lambda']$ has disappered, the new particle will break down to others. Only when $n = 12$, $\lambda'' = \lambda_v/12 = \lambda'$, the new particles will remain. We can explain as figure 2:

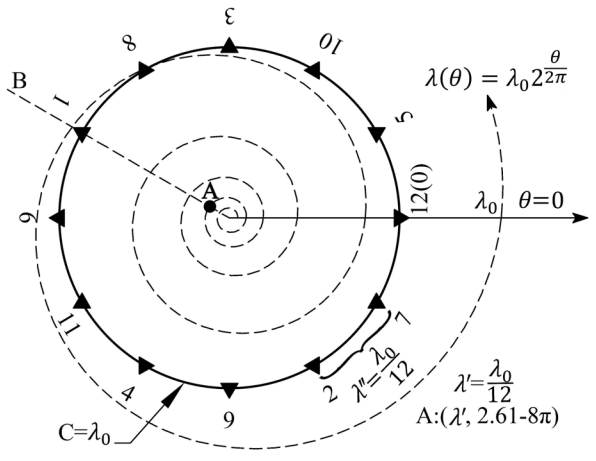

FIG. 2. Resonance diagram of $\lambda/12$

In a group of vacuum particles, wave λ_v exists as a circle wave, with perimeter equal to λ_v. And a energy spiral also exists with the same centre, the wave $[\lambda = \lambda_v]$ of which is determined by internal or external influences. When wave $[\lambda' = \lambda_v/12]$ affects on these particles, it will resonant the energy point "A" with the polar coordinate $(\lambda', 5\pi/6-8\pi)$. $[\theta(1/12) = \log_2(1/12)\times 2\pi \approx 5\pi/6-8\pi]$. "A" will transfer the energy along the line "AB" by dual resonances, this line intersects with the circle λ_v, and causes a resonant peak "1" at the point of intersection. A new energy spiral forms with the peak "1" as the start point $(\lambda_v, 0)$, wave $[\lambda' = \lambda_v/12]$ affects the new energy spiral, then causes a resonant peak "2". The energy with $\lambda_v/12$ transmits one peak by one peak, one loop by one loop, the deviation is eliminated, finally 12 resonant peaks divide the circle into 12 equal parts as figure 2. The arc length of two adjacent peaks causes a new wave $\lambda" = \lambda_v/12$. This means: if wave $\lambda_v/12$ has formed, it cannot be absorbed by original particles, and the particles with energy wave $\lambda_v/12$ is stable.

Based on this principle, the new particles gather into next particles. So vacuum particles with $E_v = hc/\lambda_v$ will gather into a series of basic particles with wavelength as $E_{vk} = hc/\lambda_{vk}$, k are nature numbers. But when k is up to 12, λ_{v12} can cause $2^n\lambda_{v12}$ by dual resonances as equation (5). Because energy $[E = hc/(2^{43}\lambda_{v12})]$ have little more energy $[+1.35\%]$ than $[E = hc/\lambda_v]$, so the energy wave of λ_{v12} can be absorbed slowly by vacuum particles λ_v through 43 times of dual resonances, and will not gather into next one, therefore there are 13 basic particles.

$$E_{vk} = 12^k E_v = 12^k hc/\lambda_v \quad (k = 0, 1, 2\cdots 12.) \tag{7}$$

One small particle E_{vk} will move around the largest particle E_{v12}. The small one will become the electron. And the largest particle will become protons.

III. ANALYZE ENERGY STRUCTURE OF HYDROGEN ATOM

In a hydrogen atom, the electron move around the proton, we will analyze them as figure 3.

#1. Vacuum wave λ_v outside resonates with energy spiral of the electron, and drives energy spiral to rotate, to make polar radius $\lambda = \lambda_v$ of energy spiral towards vacuum wave λ_v. According to the principle as equation (6), vacuum energy can transfer the energy to any energy waves $\lambda_v/2^n$. The resonance makes micro-particles "Y" with λ_b to stay at point "b", which causes energy wave λ_{e2} of revolution energy E_{e2} to synchronize with it as equation (9). Revolution energy E_{e2} calculated with equation (3) as follow.

$$E_{e2} = m_{eb}v^2 = hc/\lambda_{e2} \tag{8}$$

$$\lambda_{e2} = \lambda_b = \lambda_v/2^n \tag{9}$$

#2. With the effect by wave λ_v, electron releases the energy wave at point "a" of energy spiral, which is the start point of energy spiral and at the opposite place of point"b" as figure 3. Because micro-particles "Y" are stopped shortly at point "b" when they enter the energy spiral, and point"a" with λ_a and "b" with λ_b are at the opposite places. $\Delta\theta = \theta(\lambda_b) - \theta(\lambda_a) = \pi$. With energy spiral equation – equation(4), can get as follow:

$$\lambda_b = \lambda_a 2^{\Delta\theta/2\pi} = \lambda_a 2^{\pi/2\pi} = \sqrt{2}\lambda_a \tag{10}$$

#3. These micro-particles "Y" get energy from the rotation of electron to move away. Energy λ_a at point "a" is the start point of energy spiral, so λ_a synchronizes with energy wave λ_{e1} of rotation energy E_{e1}.

$$\lambda_a = \lambda_{e1} \tag{11}$$

#4. At point "a" of energy spiral, electron releases the energy wave λ_a, which is pointing to center of the revolution and becomes the energy radius of Bohr orbit.

$$r_\lambda = \lambda_a \tag{12}$$

With equation (9,10,11,12),(3,8), can get as follow:

$$\{\lambda_b = \lambda_{e2} = \lambda_v/2^n\} = \sqrt{2}\{\lambda_a = \lambda_{e1} = r_\lambda\} \tag{13}$$

$$E_{e1} = hc/\lambda_{e1} = \sqrt{2}hc/\lambda_{e2} = \sqrt{2}E_{e2} = \sqrt{2}m_{eb}v^2 \tag{14}$$

#5. When electron at Bohr orbit, the whole system has two basic energy waves, one is vacuum energy wave λ_v, and another is electron Bohr mass wave λ_{meb}. According to principle of dual resonance, because $\lambda_v \lggg \lambda_{meb}$, wave λ_v causes wave $\lambda_v/2^n$ towards the middle wave by n times of dual resonance, to ensure synchronization, wave λ_{meb} causes wave $2^n\lambda_{meb}$ towards the middle wave by same times of dual resonance. Finally waves $\lambda_v/2^n$ and $2^n\lambda_{meb}$ are unified by Bohr orbit. The wave λ_{meb} will expand by losing some matter slowly, until 2^n times of diameter of λ_{meb} meets the energy perimeter of for Bohr orbit, the wave λ_{meb} cannot expand no longer, and the electron will not lose matter and becoms steady.

$$2\pi r_\lambda = \lambda_{meb}/\pi \times 2^n = 2^n\lambda_{meb}/\pi \tag{15}$$

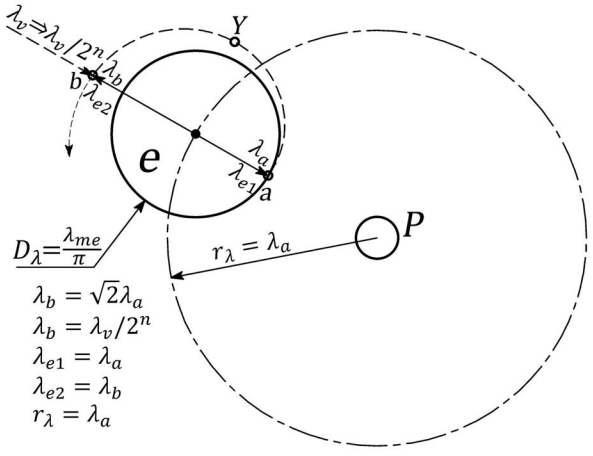

FIG. 3. Energy model of hydrogen atom

#6. Because the electron with energy E_{eb} at Bohr orbit is changed from one of basic particles with energy E_{vk} after losing some energy, with equation (2, 3, 7) can get as follow.

$$E_{eb} = m_{eb}c^2 = hc/\lambda_{meb} \lessapprox E_{vk} = 12^k hc/\lambda_v \tag{16}$$

To meet the condition #1 #2 #3 #4 #5, the particle turn some rest mass to the revolution energy and the rotation energy, finally become a electron. Combining these conditions, calculate as follows:

With equation (15,13,16), we can get as follow:

$$\begin{aligned}\lambda_{meb} =& \pi^2 r_\lambda/2^{n-1} = \pi^2\lambda_{e1}/2^{n-1} \\ =& \sqrt{2}\pi^2\lambda_{e2}\ /2^n = \sqrt{2}\pi^2\lambda_v/2^{2n} \lessapprox \lambda_v/12^k\end{aligned} \tag{17}$$

With equation (5), compare their θ of equation (17):

$$\theta(\sqrt{2}\pi^2/2^{2n}) \gtrapprox \theta(1/12^k) \tag{18}$$

$$\theta(\sqrt{2}\pi^2/2^{2n}) = 2\pi\log_2(\sqrt{2}\pi^2/2^{2n}) = 5.045 + (6-4n)\pi \tag{19}$$

$$\theta(1/12^k) = 2\pi\log_2(1/12^k) \tag{20}$$

Compare $5.045 + (6-4n)\pi$ of equation(19) to the θ of equation (20) in table1, integer n is undecided, can get that: when $k = 9$, $\theta = 4.62 - 66\pi$ in table1 is the nearest to meet equation (18).Thus

$$5.045 + (6-4n)\pi \gtrapprox 4.62 - 66\pi \tag{21}$$

$$n \lessapprox (5.045 - 4.62 + 72\pi)/(4\pi) = 18.0338 \tag{22}$$

$\because n$ is integer and is the nearest number, $\therefore n = 18$, and let n into the Equation (17) and (9):

$$n = 18 \tag{23}$$

$$\lambda_{meb} = \sqrt{2}\pi^2\lambda_v/2^{2n} = \sqrt{2}\pi^2\lambda_v/2^{36} \tag{24}$$

$$\lambda_{e2} = \lambda_v/2^n = \lambda_v/2^{18} \tag{25}$$

Fine Structure constant can be calculated with the equations (1,8,16,24,25) as follow:

$$\begin{aligned}\alpha =& v/c = \sqrt{m_{eb}v^2/(m_{eb}c^2)} = \sqrt{\lambda_{meb}/\lambda_{e2}} \\ =& \sqrt[4]{2}\pi/512 = 7.296\ 883\ 4689 \times 10^{-3}\end{aligned} \tag{26}$$

$$1/\alpha = 512/\sqrt[4]{2}\pi = 137.044\ 808\ 8227 \tag{27}$$

TABLE I.
Calculated by equation(18) ($k = 1,\ 2,\ 3 \cdots 12.$).

	θ		θ		θ
k=1	$2.61 - 8\pi$	k=5	$0.47 - 36\pi$	k=9	$4.62 - 66\pi$
k=2	$5.22 - 16\pi$	k=6	$3.08 - 44\pi$	k=10	$0.94 - 72\pi$
k=3	$1.54 - 22\pi$	k=7	$5.69 - 52\pi$	k=11	$3.55 - 80\pi$
k=4	$4.15 - 33\pi$	k=8	$2.01 - 58\pi$	k=12	$6.16 - 88\pi$

To make the revolution cycle of electron to synchronize with energy wave λ_{e2} of revolution, Bohr radius a_0 can be calculated with equation (25,26):

$$a_0 = \frac{\lambda_{e2}/c}{2\pi/v} = \frac{\lambda_v}{2^{18}} \times \frac{\alpha}{2\pi} = \frac{\alpha\lambda_v}{2^{19}\pi} = \frac{\sqrt[4]{2}\lambda_v}{2^{28}} \tag{28}$$

Formation of Bohr orbit does not connect with the proton, it can be proved with the same value of Rydberg constants of different elements. The structure of hydrogen atoms makes the proton in center to adapt to it. Because of constraint from the structure, electrons and protons do not decay. Formation of protons will be discussed in another paper.

IV. DISCUSSION

In the hydrogen atom, when electron is at the unstable orbits, it will jump into low energy internal orbits with releasing light, finally into Bohr orbit. Because electron stays at unstable orbits for short time, the rotation energy of electron remains constant by inertia during eletron transition. Analyzing the hydrogen atomic spectroscopy, we can get Rydberg constant R_∞ as follow:

$$m_{eb}v^2 = 2hcR_\infty \tag{29}$$

With equation(25,8,29),vacuum energy or Vacuum particle is calculated as follow:

$$\lambda_v = \lambda_{e2}2^{18} = \frac{2^{18}hc}{m_{eb}v^2} = \frac{2^{18}hc}{2hcR_\infty} = \frac{2^{17}}{R_\infty} \tag{30}$$

According to Mass energy equation, electron Bohr mass m_{eb} matches the total energy of the electron E_{eb} at Bohr orbit, including rest mass energy E_{me0} and rotation energy E_{e1} and revolution energy E_{e2}. (Rotation energy E_{e1} is difficult to measure and was often ignored.) With equation(31,2,16,14,8) can get as follow:

$$E_{meb} = E_{eb} = E_{me0} + E_{e1} + E_{e2} \tag{31}$$

$$m_{eb}c^2 = m_{e0}c^2 + \sqrt{2}m_{eb}v^2 + m_{eb}v^2 \tag{32}$$

with equation (32,1,29) can get as follow:

$$m_{e0} = m_{eb}[1 - (\sqrt{2}+1)\alpha^2] \tag{33}$$

$$m_{eb}v^2/\alpha^2 = m_{e0}c^2 + \sqrt{2}m_{eb}v^2 + m_{eb}v^2$$

$$1/\alpha^2 - \sqrt{2} - 1 = m_{e0}c^2/m_{eb}v^2 = m_{e0}c^2/2hcR_\infty$$

$$\alpha = 1/\sqrt{m_{e0}c/2hR_\infty + \sqrt{2} + 1} \tag{34}$$

Let Physical Constants in table 2 into equation (34), α' for experiment as follow, and compare α' to logicial value α of equation (26):

$$\alpha' = 7.296\ 883\ 5364 \times 10^{-3} \tag{35}$$

$$\alpha'/\alpha = 1 + 9.25 \times 10^{-9} \tag{36}$$

As can be seen from eqution(36), to Fine Structure constant, the data calculated with experimental data agrees logicial value. The logic value [$\alpha = \sqrt[4]{2}\pi/512$] is reliable.

If both the revolution and the rotation of electron at Bohr orbit are ignored, with the rest mass m_{e0} as the Bohr mass m_{eb}, then the value of Fine Structure constant will be calculate as the data in CODATA 2014.

$\alpha = \sqrt{2hR_\infty/m_{e0}c} = 7.297\ 352\ 565\ 533 \times 10^{-3}$

Additional: Theoretical values of physical constants for hydrogen atom calculated with h, c, R_∞

$$m_{e0} = \frac{2hR_\infty}{c}(\frac{1}{\alpha^2} - \sqrt{2} - 1) = 9.109\ 383\ 729\ 63 \times 10^{-31}kg$$

$$a_0 = \alpha/4\pi R_\infty = \sqrt[4]{2}/2^{11}R_\infty = 0.529\ 143\ 1935 \times 10^{-10}m$$

$$r_e = \pi a_0/2^{18} = \sqrt[4]{2}\pi/2^{29}R_\infty = 6.341\ 371\ 0374 \times 10^{-16}m$$

$$e = \sqrt{10^7 h\alpha/2\pi c} = 1.602\ 125\ 1235 \times 10^{-31}C$$

V. CONCLUSION & EXPECTATION

In this paper, new physical models are established by energy spirals and resonances, and the Fine Structure constant is explained by pure logic calculation. It is rare in scientific research. These theories deserve to be applied in scientific research

In this paper, there are some extra discoveries.

(1) Every dual resonance spends ultrashort time without limit of length, and its speed is far over speed of light. Quantum entanglement is building on this principle.

(2) Light transmits on vacuum particles, and the speeds of light are different in different vacuum environments.

(3) Mass should be calculated with Mass energy equation, not as relativistic mass equation by Lorentz transformation.

(4) Electrons are always going to enter the Bohr orbit, and coulomb force and electron charge are the external expression. The energy of electrons and protons is sealed in atoms, and only little energy leaks out, so gravitation becomes very small.

TABLE II.
Physical Constants checked in CODATA:2014

	Symbol	Numerical value
light speed in vacuum	c	299 792 458 m/s
Planck constant	h	$6.626\ 070\ 040(81) \times 10^{-34}$Js
Rydberg constant	R_∞	10 973 731.568 508 (65)m^{-1}
electron mass	m_e	$9.109\ 383\ 56(11) \times 10^{-31}$kg
Bohr radius	a_0	$0.529\ 177\ 210\ 61(12) \times 10^{-10}$m
electron radius	r_e	$2.817\ 940\ 3227(19) \times 10^{-15}$m
elementary charge	e	$1.602\ 176\ 6208(98) \times 10^{-31}$C
fine-structure constant	α	$7.297\ 352\ 5664(17) \times 10^{-3}$