How to Derive The Fine-structure Constant--$1/\alpha = Fn/F_e = hC/(2\pi e^2)$ From Author's New Black-hole Theory and Formulas?

Zhang Dongsheng
zhangds12@hotmail.com; zds@outlook.com

【Abstract】。What is the fine-structure constant--$1/\alpha = hC/(2\pi e^2) = 137.036$? It has been an important problem not recognized and unsolved by scientists for more 50 years. A Chinese old famous saying: The stones of other hills may be good for making jades.Applying the hydrogen atom as a model and contrast, a proper ratio F_e/F_g between the electrical force F_e and the gravitational force F_g could be really established as a famous Dirac large number $L_n = F_e/F_g \approx \mathbf{10^{39}}$, because in a hydrogen atom, either the electron or the proton can be acted by the electrical force F_e and the gravitational force F_g together; in addition, F_n and F_e have the same acting distance R. Right now, physicists have not found the correct formula or numerical value of nuclear strong force—F_n. Drawing the same mathematical and physical analogy from $L_n = F_e/F_g$, a special mini black hole of $M_{bo} = 0.71\times10^{14}$g can be a better choice as a model, in which each one of all quarks decomposed from protons must be acted by the electrical force F_e and the nuclear strong force F_n together. Thus, the proper ratio F_n/F_e between F_n and F_e can be correctly established and proved that, F_n/F_e should just be the fine-structure constant, and $F_n/F_e = 1/\alpha = hC/(2\pi e^2) = 137.036$.Richard Feynman once said some words about the fine-structure constant: **[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."]

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【Key Words】。fine-structure constant $F_n/F_e = 1/\alpha = hC/(2\pi e^2) = 137.036$; the physical meanings of fine-structure constant--$1/\alpha$; Dirac large number $F_e/F_g = L_n = 10^{39}$; the special mini black hole of $M_{bo} = \mathbf{0.71}\times10^{14}$g;

【1】。the fine-structure constant--$1/\alpha$ may be defined as $1/\alpha = hC/(2\pi e^2) = 137.036$, so,

$$1/\alpha = hC/(2\pi e^2) = 137.036 = F_n/F_e \quad \textbf{(1a)}$$

In above formula (1a), Planck constant--h = 6.626×10^{-27}g*cm²/s; light speed--C = 2.998×10^{10} cm/s; electronic charge--e=4.80325×10^{-10}esu=1.6022×10^{-19}C (Coulomb); then, $1/\alpha = hC/(2\pi e^2) = 6.626\times10^{-27}\times2.998\times10^{10}/[2(4.80325\times10^{-10})^2] = 137.0368 \approx 137.036$.

Formula (1a) can be derived step by step as follows.

Taking a special mini black hole of $M_{bo}= 0.71\times10^{14}$g as a model, in which there should be full of pure quarks decomposed from protons. Every quark could be acted by nuclear strong force F_n and electrical force F_e together. Thus, the ratio of $F_n/F_e = 1/\alpha = 137.036$ would be derived out with the same distance R。

Annotations : In this article, F_n, F_e, F_g are not the real strong force, electrical force and gravitational force, they are used for getting the ratios of F_n/F_e, F_e/F_g, F_n/F_g. The fundamental forces in the universe, i.e, the real strong force **Fn**, electrical force **Fe** and gravitational force **Fg** should be :

$$\mathbf{Fn=F_n/R^2,\quad Fe=F_e/R^2,\quad Fg=F_g/R^2} \quad (a)$$

【2】。$F_e/F_g = L_n = 2.27\times10^{39}$ = Dirac large number could be verified with the model of a hydrogen atom.

First, let us look back how to get the Dirac large number—L_n. Taking a hydrogen atom as a model, in which a electron on the surface can possess a e^- (= e^+ = 1.602×10^{-19} C), and mass m_e= 9.1096×10^{-28}g, a proton in the center can possess a e^+ and a proton of mass m_p =1.6727×10^{-24}g, the atomic radius is R, G = the gravitational constant= 6.6726×10^{-8} cm³/s²*g, k = the measured proportional constant=9.0×10^9N•m²/C². Then, the electrical force F_e and the gravitational force F_g are :

$$\mathbf{F_g} = Gm_pm_e/R^2 = 6.6726\times10^{-8}\times1.6727\times10^{-24}\times9.1096\times10^{-28}/R^2 = \mathbf{101.67\times10^{-60}/R^2} \text{ [3]} \quad (2a)$$

$$\mathbf{F_e} = ke^2/R^2 = 9.0\times10^9N\cdot m^2/C^2\times(1.6022\times10^{-19}C)^2/R^2 = 9.0\times10^9\times10^5\times10^4\times(1.6022\times10^{-19}C)^2/R^2 = \mathbf{23.10\times10^{-20}/R^2} \text{ [3]} \quad (2b)$$

$$\mathbf{F_e/F_g = L_n} = 23.10\times10^{-20}/101.67\times10^{-60} = \mathbf{2.27\times10^{39}} \text{ [3]} \quad (2c)$$

Formula (2c) shows that, in hydrogen atom, the distance R is the same for F_e and F_g, Then, the no dimension constant L_n is; $L_n = ke^2/Gm_pm_e = 2.27\times10^{39} = F_e/F_g$. The ratio of F_e/F_g shows the electrical force F_e/ the gravitational force F_g.

【3】。Some basic and general formulas of black holes (BH)

Formula (3a) below is the famous temperature formula of Hawking black-hole theory.

$T_b M_b = (C^3/4G)\times(h/2\pi\kappa) \approx 10^{27}gk$ [1] (3a)

M_b—total mass of any black hole; R_b—the Event Horizon of black hole M_b, i.e, radius of M_b; T_b—temperature on R_b; m_{ss}—the corresponding mass of Hawking quantum radiation on R_b; κ—Boltzmann constant = $1.38\times10^{-16} g{*}cm^2/s^2{*}k$,

Since m_{ss} could be the Hawking quantum radiation on R_b, it should accord with the law between valve temperature and energy transformation.

$m_{ss} = \kappa T_b / C^2$ [1] [2] (3b)

According to Schwarzschild's special solution to General Theory of Relativity (GTR), the necessary condition for the existence of any black holes must be,

$GM_b/R_b = C^2/2$ [1][2] (3c)

New important formula (3d) was easily derived by author from formulas (1a) and (1b),

$m_{ss} M_b = hC/8\pi G = 1.187\times10^{-10} g^2$ **(3d)**

【4】。The specific properties of the special mini black hole of $M_{bo} = 0.71\times10^{14}$g

According to the Hawking's famous entropy formula below (4a) of black holes, in the process of the collapse of any star, it could increase in its entropy and decrease in its information amount. Suppose S_b—the entropy before its collapse; S_a—the entropy after its collapse; M_θ—sun mass = 2×10^{33}g, then,

$S_a/S_b \approx 10^{18} M_b/M_\theta$ [1][2] **(4a)(8a) (8a)**

Jacob Bekinstein pointed out, under the ideal condition, while in the collapse process of a star from its beginning to its end, if $S_a = S_b$ occurred, from (4a), a mini black hole of $M_{bs} \approx 2\times10^{15}$g could be got, it was so-called original mini black hole in the universe. Its density of M_{bs} --$\rho_{bs} \approx 1.8\times10^{52} g/cm^3$.

Howeer, for the calculative convenience as follows, **a special mini black hole of $M_{bo} = 0.71\times10^{14}$g may be taken。**

For the calculative convenience as below, a special smaller mini black hole (BH) of $M_{bo} = 0.71\times10^{14}$g can be taken as a model.

From above formulas (3a), (3b), (3c) and (3d), **under the condition of $M_{bo} = 0.71\times10^{14}$g**, its radius $R_{bo} = 1.05\times10^{-14}$cm; the temperature on its Event Horizon $T_{bo} = 1.09\times10^{13}$k; mass m_{sso} of Hawking quantum radiation on its Event Horizon R_{bo}--$m_{sso} = m_p = 1.67\times10^{-24}$g = a proton mass; the average density of M_{bo}--**$\rho_{bo} = 2.57\times10^{56} g/cm^3$**; n_p-- the proton total of M_{bo},

$n_p = M_{bo}/m_p = 0.71\times10^{14}/1.67\times10^{-24} = \mathbf{0.425\times10^{38}}$ （4b）

Bekinstein just did a simple mathematical treatment to formula (4a), and pointed out that, a mini black hole of $M_{bs} \approx 2\times10^{15}$g might exist in the universe in the past. However, **Bekinstein did not research the profound physical meaning of (4a).**

From Bekinstein's explanations to the entropy conservation in the collapse process of a star, a very importantly significant conclusion can be gotten. First, formula (4a) shows that, entropy could not keep a constant in the collapse process of stars > $M_{bs} \approx 2\times10^{15}$g. Second, the physical significance of entropy conservation shows that, only after quarks decomposed from protons could have no heat movement and no friction, they would enter in the ideal condition. Thus, quarks either in a contractive or in an expansive process between densities $1.8\times10^{52} g/cm^3$ and $10^{93} g/cm^3$, they should be in the ideal process of no heat movement and no friction.

It is said, only after all protons, which densities ρ_{bs} could be higher than $1.8\times10^{52} g/cm^3$ of $M_{bs} \approx 2\times10^{15}$g, would decompose into pure quarks, i.e, every proton decomposed into 3 'uud' quarks, and they would be in the ideal conditions. On the contrary, while the protons as particles not decomposed, which densities ρ_{bs} could be smaller than $1.8\times10^{52} g/cm^3$ of $M_{bs} \approx 2\times10^{15}$g, they would not be in the ideal conditions, and still keep the structures of protons.

Thus, according to $\rho_{bo} = 2.57\times10^{56} g/cm^3$ of $M_{bo} > 1.8\times10^{52} g/cm^3$, the mini BH-- $M_{bo} = 0.71\times10^{14}$g taken by author as a model is formed by all pure quarks decomposed from protons and is in the ideal conditions. Every 3 quarks with 3 different colors must be bundled up together.

In modern physics,[5] quark model and its structures inside have not be recognized still yet, only some properties of quarks relevant to the nuclear strong force F_n can be simply described below: 1*; According to the theories of modern particle physics and quantum chromodynamics (QCD), quarks are all tied up inside protons, no quark could exist singly and freely. 2*, A proton is formed by 3 quarks of 'uud' with 3 different colors—green, blue and red, every quark has its special color. Only 3 quarks bundled together with above 3 colors can form a white color. There are nuclear gravitational force and exclusive force between any 2 quarks in any proton, it let those 3 quarks exist separately and keep some distance R between them, but let them not be combined together, so that keep their balance and their stability. Color may be the source of nuclear strong forces and be the expression of Pauli exclusion principle. 3*, There are 2 'u' quarks and a 'd' quark in a decomposed proton, every 'u' quark has $2e^+/3$ electrical charge, and a 'd' quark has $e^-/3$ electrical charge. In 3 'uud' quarks, the electrical force between 2 'uu' quarks is positive and equal to $(+4e^+/9)$. 2 electrical forces between 2 'ud' quarks are negative, and equal to $(-2e^-/9) + (-2e^-/9) = (-4e^-/9)$. Therefore, the positive and negative electrical forces are in the state of balance in a proton. All quarks decomposed from protons scattered in the whole space of $M_{bo} = 0.71\times10^{14}$g. 4*, It can be seen, every quark can be acted simultaneously by nuclear strong force F_n and electrical force F_e, so, **the**

distance R between any 2 quarks is the same for F_n and F_e. Thus, it will be simple and easy for us to find out F_n/F_e.

【5】。How to use special mini BH of M_{bo} = 0.71 ×10^{14}g to find the nuclear strong force F_n between any 2 quarks, and the ratio F_n/F_e?

The nuclear strong force F_n between 2 close quarks and the ratio of F_n/F_e can be got below, F_e—the electrical force between 2 same quarks. From **(3d),**

$$m_{ss}M_b = hC/8\pi G \quad (3d)$$

Let F_n be the nuclear strong force between any 2 quarks in M_{bo}, and let F_n be;

$$F_n = hC/2\pi \quad (5a)$$

(3d) may be changed into

$$4GM_{bo}m_{sso} = F_n = hC/2\pi = 6.63\times10^{-27}\times2.998\times10^{10}/2\pi = 3.17\times10^{-17} \quad (5b)$$

or, $F_n/R^2 = 4GM_{bo}m_{sso}/R^2 = hC/2\pi R^2$,

$$Fn = F_n/R^2 = GM_{bo}m_{sso}/R^2 \quad (5c)$$

Owing to the electrical force F_e between electrical charges e^+ and e^-,

$$F_e = e^2 = 23.10\times10^{-20}, \quad Fe = F_e/R^2$$

$$\therefore F_n/F_e = Fn/Fe = hC/2\pi e^2 = 137.036 = 1/\alpha \quad (5d)$$

$$\therefore (5d) \equiv (1a) \quad (5e)$$

Moreover, if the gravitational force F_g between any 2 close quarks existed as normal, then,

$$F_n/F_g = F_n/F_e\times F_e/F_g = L_n/\alpha = 2.27\times10^{39}\times 137.036 = 3.11\times10^{41} \quad (5f)$$

3 formulas (5d), (5e), (5f) are the right results verified by author.

1*。**It must be pointed out that, (5b) can only be tenable for all black holes, but for non-BHs, $4GM_{bo}m_{sso} \neq$ constant。Second, $F_n = hC/2\pi$ is tenable for all BHs, but different BHs can have different R, so, $Fn = F_n/R^2 \neq$ constant to different BH.**

2*。 From (5b), changing $4GM_{bo}m_{sso} = F_n = hC/2\pi$ into $4GM_{bo}m_{sso}/F_e = F_n/F_e = hC/2\pi e^2$,

then, $4GM_{bo}m_{sso}/F_e = 4\times6.67\times10^{-8}\times0.71\times10^{14}\times1.67\times10^{-24}/23.1\times10^{-20} = 137 = F_n/F_e$

$\therefore F_n/F_e = hC/2\pi e^2 = 1/\alpha = 137.036$

The correctness of (5d) ≡ (1a) can be verified again。

In modern physics, $F_n/F_e \approx 10^2$ may be estimated, but nobody finds out the physical meaning about the fine-structure constant of $1/\alpha = F_n/F_e$。(5d) ≡ (1a) can be first derived by author with a special mini BH of M_{bo} = 0.71×10^{14}g as a model.

3*. From formula (a), in BH of M_{bo} = 0.71×10^{14}g, the real nuclear strong force Fn and electrical force Fe are:

$$Fn = F_n/R^2 = hC/2\pi R^2 = 3.16\times10^{-17}/R^2$$
$$Fe = F_e/R^2 = e^2/R^2 = 2.31\times10^{-19}/R^2$$

What is R here? R should be the distance between 2 close quarks。

From above calculation, radius R_{bo} of $\mathbf{M_{bo}}$ is 1.05×10^{-14}cm, from (4b), $\mathbf{n_p = 0.425\times10^{38}}$,

$$n_pR^3 = R_{bo}^3, \quad R = 3\times10^{-27}\text{cm} \quad (5g)$$

4*。How much strong is Fn between 2 quarks?

Suppose R = 3×10^{-27}cm as above, so,

$R^2 \approx 9\times10^{-54}$cm,

$\therefore Fn = hC/2\pi R^2 = 6.626\times10^{-27}\times2.998\times10^{10}/(2\pi\times9\times10^{-54}) = 0.3515\times10^{37}$dyne,

$\therefore Fe = e^2/R^2 = 23.1\times10^{-20}/9\times10^{-54} = 2.567\times10^{34}$ dyne. thus,

$$F_n/F_e = Fn/Fe = 0.3515\times10^{37}/2.567\times10^{34} = 136.92 \approx 137.036 = hC/2\pi e^2 = 1/\alpha \quad (5d)$$

5*, Let F_{Mm} be the gravitational force between M_{bo} and its m_{sso}, then,

$$F_{Mm} = 4GM_{bo}m_{sso}/R_{bo}^2 = 4\times6.67\times10^{-8}\times0.71\times10^{14}\times1.67\times10^{-24}/(1.05\times10^{-14})^2 = 3.17\times10^{-17}/(1.05\times10^{-14})^2 = 2.88\times10^{11}\text{dyne} \quad (5h)$$

I have to do some explanations about <$F_{Mm} = 4GM_{bo}m_{sso}/R_{bo}^2$>. In Newton mechanics, M_{bo} is recognized as a concentrated mass in the center, so, $F_{Mm} = GM_{bo}m_{sso}/R_{bo}^2$. However, in a black hole, M_{bo} from (3c) come from General Theory of Relativity should be scattered in its whole space, so, $F_{Mm} = 4GM_{bo}m_{sso}/R_{bo}^2$. It shows that, the gravitational force of scattered mass to a particle on the surface is 4 times of concentrated mass to the same particle.

6*, An interesting inference

From (5b), $\mathbf{4GM_{bo}m_{sso} = F_n = hC/2\pi}$,

$\therefore 4GM_{bo}m_{sso}/R^2R_{bo}^2 = (hC/2\pi)/R^2R_{bo}^2$, so,

$(4GM_{bo}m_{sso}/R_{bo}^2)/[(hC/2\pi)/R^2] = R^2/R_{bo}^2$

From(5c) and (5h).

$$\therefore F_{Mm}/F_n = R^2/R_{bo}^2 \quad (5i)$$

From (5g), $R_{bo}^2/R^2 = n_p^{2/3}$

$$\therefore F_n/F_{Mm} = R_{bo}^2/R^2 = n_p^{2/3} \quad (5j)$$

Formula (5j) may unexpectedly let the nuclear strong force F_n connect with the gravitational force F_{Mm} of M_{bo} to its Hawking quantum radiation m_{sso},

It can be known from BH theory,[1] once M_{bo} would decrease in its mass due to emitting m_{sso}, then, the next m_{sso} could increase in its mass. Moreover, the decrease in R_{bo}^2 > the decrease in R^2. Following M_{bo} reduced its mass, the mass of protons in M_{bo} would grow up into hyperons, thus, M_{bo} would go to the limited condition of $M_{bo} = m_{sso}$, at that time, according to (3d),

$\mathbf{M_{bo} = m_{sso} = 10^{-5}}$**g,** and (5j) would change into,

$\mathbf{F_n = F_{Mm}}$, $\mathbf{R_{bo}^2 = R^2}$, **and,**

$\mathbf{n_p = 1}$ **the greatest hyperon**

According to the BH theory,[1] $\mathbf{M_{bo} = m_{sso} = 10^{-5}}$ **g** would explode into γ-rays and disappear in Planck Era.

【6】。The further analyses and conclusions:

1*. It can be seen from above paragraph【4】, the density ρ_{bo} of M_{bo} = 0.71×10^{14}g can reach to 10^{56}g/cm^3 > ($\rho_{bs} \approx 1.8\times10^{52}$g/cm^3) of $M_{bs} \approx 2\times10^{15}$g, so, M_{bo} is formed by 3× n_p pure quarks decomposed from protons.

From formulas (5c) , (5d) and (5d) ≡ (1a), it can be known that, the fine-structure constant--1/α may be just the ratio F_n/F_e. **Obviously, owing to that, $F_n/R^2 = hC/2\pi R^2$ and $F_e/R^2 = e^2$ have some common properties, such as the common R and the common dimensions.**

From formula (5d), $F_n/F_e = hC/2\pi e^2 = 137.036 = 1/\alpha$ can be derived out. It can be known, from formula (5c), $Fn = F_n/R^2 = 4GM_{bo}m_{sso}/R^2$, the property of F_n may be analogous with the gravitational force between 2 particles.

2*。 What is the physical meaning of $F_n/F_e = hC/2\pi e^2$?

In reference [4], it was verified that, $h/2\pi = I_o$. [4] I_o must be a basic information unit, so,

$$F_n = Ch/2\pi = CI_o \qquad (6a)$$

It show that, the nuclear strong force F_n could deliver the basic information unit I_o with light speed C by gluons, just as F_e deliver the basic information unit I_o with light speed C by photons. $hC/2\pi e^2$ shows that, F_n for delivering gluons are much stronger than (1/α) F_e for delivering photons.

3*. $F_n/F_e = 137.036 = 1/\alpha$ can be almost analogous with $F_e/F_g = 2.27\times10^{39} = L_n$. Since L_n may be as the coincident coefficient of F_e/F_g in physics. Similarly, α is as a coincident coefficient of F_n/F_e too. Therefore, it may be reasonable for $1/\alpha = F_n/F_e$ as a coincident coefficient.

4*. Since L_n as a special non-dimension coefficient could have the general significance in the universe, then α should too.

5*. However, it will be very difficult for scientists to know why $F_n/F_e = hC/2\pi e^2 = 137.036 = 1/\alpha$ in (5d) is a so precisely equal formula, because the instrument for observing the structure inside quarks will be very hardly manufactured in short future.

6*. The right conclusions to derive $1/\alpha = F_n/F_e = hC/(2\pi e^2)$ may verify the correctness of author 's new black-hole theory and formulas.

====The End====

Author:
Zhang Dongsheng (张洞生)
zhangds12@hotmail.com
zds@outlook.com;

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