A Concise Formula of the Anomalous Magnetic Moment of Electron and the Fine-structure Constant

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Dedicated to Prof. Albert Sun-Chi Chan on the occasion of his 70th birthday

Abstract

This paper is a subsequent paper to our previous papers "Schrödinger Equation of Hydrogen Atom in Atomic Unites, Theory of Chirality and the Territory of Modern Physics" (viXra:2103.0088v3). In the end of this previous paper, we gave formulas and values of the anomalous magnetic moment (a=(g-2)/2) of electron and muon. In this paper, we test the value of the anomalous magnetic moment of electron ($a_e=(g_e-2)/2$) given in the previous paper by a new method which employs our formulas of the fine-structure constant and quantization of 2π, and hence we have verified the value to be precise and give a concise formula of the anomalous magnetic momentum of electron (a_e) and the fine-structure constant (α_2).

Keywords: formula; value; the anomalous magnetic moment; electron; the fine-structure constant.

1. Introduction

In our previous paper[1], we gave a new formula of the anomalous magnetic moment ($a_e=(g_e-2)/2$) of electron and suppose it to relate to nuclides.

$$a_e = \frac{g_e-2}{2} = \frac{1}{2\cdot(16\cdot 27-1)} - \frac{1}{2\cdot 7\cdot 11\cdot(16\cdot 3\cdot(4\cdot 7\cdot 11-1)+1)} = 0.00115965218135$$

$${}^{16,17,18}_{8}O_{8,9,10} \quad {}^{23}_{11}Na_{12} \quad {}^{28,30}_{14}Si_{14,16} \quad {}^{32,33,34,36}_{16}S_{16,17,18,20} \quad {}^{46,48,49,50}_{22}Ti_{24,26,27,28} \quad {}^{54}_{26}Fe_{28} \quad {}^{59}_{27}Co_{32}$$

$${}^{60,61,64}_{28}Ni_{32,33,36} \quad {}^{72,74,76}_{32}Ge_{40,42,44} \quad {}^{75}_{33}As_{42} \quad {}^{96}_{42}Mo_{54} \quad {}^{98,100}_{44}Ru_{54,56} \quad {}^{131}_{54}Xe_{77}$$

CODATA recomended values: $a_e = \dfrac{g_e-2}{2} = 0.00115965218128(18)$

With experiment determined values of the anomalous magnetic moment of electron (a_e), physicists can calculate the fine-structure constant (α) by means of Quantum Electrodynamics (QED). However, the calculation is much complicated and usually employs super-computer. In this paper, we introduce a simply method to connect the anomalous magnetic moment of electron to the fine-structure constant.

2. A Concise Formula of the Anomalous Magnetic Moment of Electron and the Fine-structure Constant

In December 1947, Schwinger gave the first formula between the anomalous magnetic moment of electron and the fine-structure constant as follows based on Quantum Electrodynamics.

$$a_e \approx \frac{\alpha}{2\pi}$$

However, the subsequently developed more precise calculation methods are much complicated and demand super-computers. And if the experiment determined a_e is not enough accurate, the calculated α shouldn't be satisfying precise either.

In our previous papers[1-7], we gave many formulas of the fine-structure constant, the most two typical formulas along with our 2π-e formula are listed as follows.

$$\alpha_1 = \frac{36}{7\cdot(2\pi)_{Chen-112}} \frac{1}{112+\frac{1}{75^2}} = 1/137.035999037435$$

$$\alpha_2 = \frac{13\cdot(2\pi)_{Chen-278}}{100} \frac{1}{112-\frac{1}{64\cdot 3\cdot 29}} = 1/137.035999111818$$

$2\pi - e$ formula:

$$(2\pi)_{Chen-k} = e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots \frac{e^2}{(\frac{k+1}{k})^{2k+1}}$$

In these formulas, we developed a methodology that the natural constant 2π was quantized, i. e., 2π-e formula could only adopt definite natural number k rather than infinity. So, with Schwinger formula and our 2π quantization method, we can construct the relationship formula between the anomalous magnetic moment of electron and the fine-structure constant as follows.

$$a_e = \frac{\alpha_2 \gamma}{(2\pi)_{Chen-109}} = \frac{\alpha_2 (1 + \frac{1}{25 \cdot 11 \cdot 47 \cdot 109})}{(2\pi)_{Chen-109}}$$

$$= \frac{1 + \frac{1}{11 \cdot 25 \cdot 47 \cdot 109}}{137.035999111818 \cdot 6.29271247440151} = 0.00115965218134971$$

$$a_e = \frac{\alpha_2 \gamma}{(2\pi)_{Chen-109}} = \frac{(\frac{13 \cdot (2\pi)_{Chen-278}}{100} \frac{1}{112 - \frac{1}{64 \cdot 3 \cdot 29}})(1 + \frac{1}{25 \cdot 11 \cdot 47 \cdot 109})}{(2\pi)_{Chen-109}}$$

$$= \frac{13 \cdot (2\pi)_{Chen-278}}{100 \cdot (2\pi)_{Chen-109}} \frac{(1 + \frac{1}{25 \cdot 11 \cdot 47 \cdot 109})}{112 - \frac{1}{64 \cdot 3 \cdot 29}}$$

$$= \frac{13 \cdot e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots \frac{e^2}{(\frac{9 \cdot 31}{278})^{557}}}{100 \cdot e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots \frac{e^2}{(\frac{110}{109})^{3 \cdot 73}}} \frac{(1 + \frac{1}{25 \cdot 11 \cdot 47 \cdot 109})}{112 - \frac{1}{64 \cdot 3 \cdot 29}}$$

$$= 0.00115965218134971$$

${}^{23}_{11}Na_{12}$ ${}^{27}_{13}Al_{14}$ ${}^{46,47,48,49,50}_{22}Ti_{24,25,26,27,28}$ ${}^{50,52,53,54}_{24}Cr_{26,28,29,30}$ ${}^{55}_{25}Mn_{30}$ ${}^{54,56,57,58}_{26}Fe_{28,30,31,32}$

${}^{63,65}_{29}Cu_{34,36}$ ${}^{69,71}_{31}Ga_{38,40}$ ${}^{83,84}_{36}Kr_{47,48}$ ${}^{93}_{41}Nb_{52}$ ${}^{107,109}_{47}Ag_{60,62}$ ${}^{110,112}_{48}Cd_{62,64}$ ${}^{112,114,116}_{50}Sn_{62,64,66}$

${}^{125}_{52}Te_{73}$ ${}^{157,158}_{64}Gd_{93,94}$ ${}^{169}_{69}Tm_{100}$ ${}^{185,187}_{75}\mathrm{Re}_{110,112}$ ${}^{186,4\cdot 47,192}_{76}Os_{110,112,116}$ ${}^{209}_{83}Bi^{*}_{126}$ ${}^{209}_{84}Po^{*}_{125}$ ${}^{223}_{87}Fr^{*}_{136}$

${}^{5\cdot 47,238}_{92}U^{*}_{11\cdot 13,2\cdot 73}$ ${}^{257}_{100}Fm^{*}_{157}$ ${}^{287}_{112}Cn^{*}_{173}$ ${}^{278}_{109}Mt^{*}_{169}$ ${}^{2\cdot 157}_{126}Ch^{ie}_{4\cdot 47}$ ${}^{344,346,12\cdot 29}_{136,137,138}Ch^{ie}_{208,209,210}$ ${}^{426}_{169}Ch^{ie}_{257}$

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3. Discussion and Conclusion

Briefly, we gave a new formula between the anomalous magnetic moment of electron and the fine-structure constant as follows.

$$a_e = \frac{\alpha_2 \gamma}{(2\pi)_{Chen-109}} = \frac{13 \cdot (2\pi)_{Chen-278}}{100 \cdot (2\pi)_{Chen-109}} \frac{(1 + \frac{1}{25 \cdot 11 \cdot 47 \cdot 109})}{112 - \frac{1}{64 \cdot 3 \cdot 29}}$$

$$= 0.00115965218134971$$

${}^{47}_{22}Ti_{25}$ ${}^{55}_{25}Mn_{30}$ ${}^{54,56,57,58}_{29}Fe_{28,30,31,32}$ ${}^{63,65}_{29}Cu_{34,36}$ ${}^{107,109}_{47}Ag_{60,62}$ ${}^{110,112}_{48}Cd_{62,64}$ ${}^{125}_{52}Te_{73}$

${}^{157,158}_{64}Gd_{93,2\cdot 47}$ ${}^{169}_{69}Tm_{100}$ ${}^{186,4\cdot 47,192}_{76}Os_{110,112,116}$ ${}^{5\cdot 47,238}_{92}U^{*}_{11\cdot 13,2\cdot 73}$ ${}^{257}_{100}Fm^{*}_{157}$ ${}^{278}_{109}Mt^{*}_{169}$

$$(2\pi)_{Chen-k} = e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots \frac{e^2}{(\frac{k+1}{k})^{2k+1}}$$

The relationships between the factors in the formula such as 11, 25, 47, 109 and 278 and nuclides strongly indicate this formula and the value should be correct and precise. It also shows that the quantization of 2π, i.e., 2π-e formula's taking definite k rather than infinity, has the same effect as Quantum Electrodynamics calculation, this means that in the world of nuclides 2π is quantized to be the form of $(2\pi)_{\text{Chen-k}}$ or some approximate fractional numbers like $4\times157/100$.

It is just like taking a clear photo from a moving object to calculate the fine-structure constant from experiment determined the anomalous magnetic moment of electron. Quantum Electrodynamics method is to calculate the moving details, our method is to add adjusting coefficients, different paths get to the same goal.

4. Comparison of Calculated and Measured Values of the Fine-structure Constant

In our previous paper[4], we gave the following figure to illustrate comparison of calculated and measured values of the fine-structure constant. In it, the lines 4 and 5 were in black. Here in this paper, we make a correction to change them to be in red. That means g-2 method corresponds to α_2.

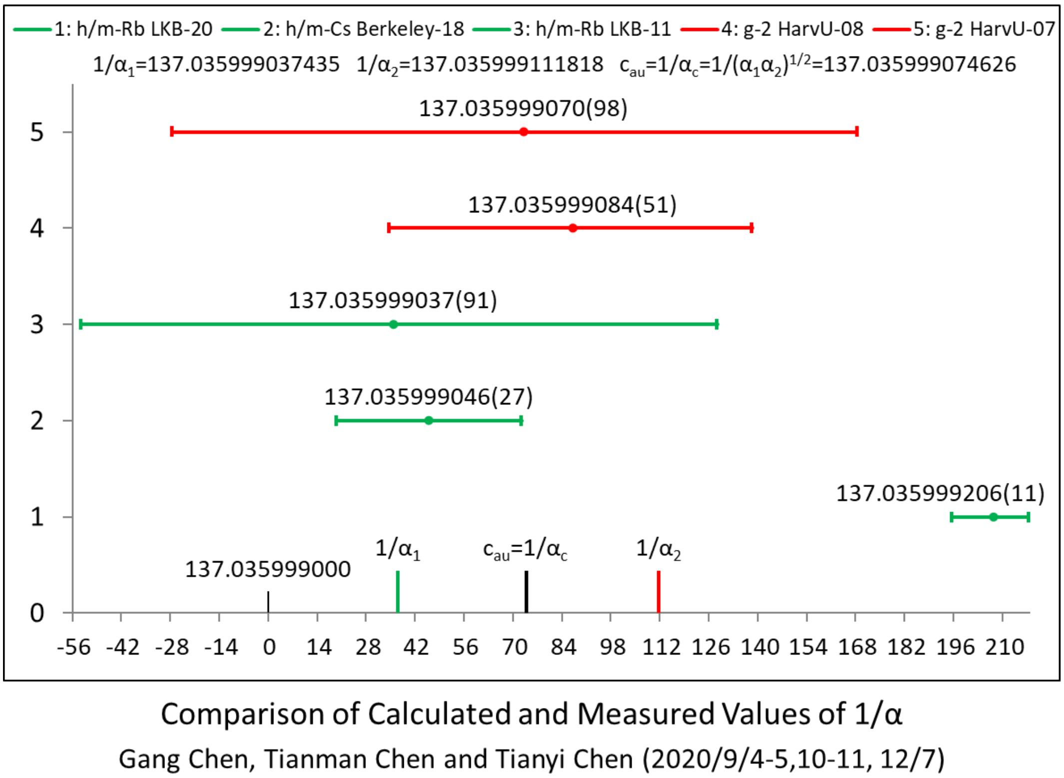

Fig. 1.

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Appendix I: Research History

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Note: Date was recorded according to Beijing Time.