The Final Formulas of the Anomalous Magnetic Moment of Electron, Muon and Tauon

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Abstract

This paper is a subsequent paper to our previous paper "Concise Formulas of the Anomalous Magnetic Moment of Electron/Muon/Tauon and the Fine-structure Constant" (viXra:2106.0042v5), in which we gave some formulas and values of the anomalous magnetic moment (a=(g-2)/2) of electron, muon and tauon. For example, we calculated the values of the anomalous magnetic moment of muon to be 0.00116592057152 and 0.00116592057075 on 2021/6/13 and 2023/3/10 respectively, and with 3 less digits they have the same value of 0.00116592057. On 2023/8/10 Fermilab Muon g-2 Collaboration announced their latest measurement of the anomalous magnetic moment of muon to be 0.00116592057(25), which should be perfectly consistent with our calculations or predictions. In this paper, we give the final formulas of the anomalous magnetic moment of electron, muon and tauon, prediction to Fermilab muon g-2 collaboration's next measurement to be 0.00116592057(15), and correlations of 2π-e formula to elements and elementary particles.

Keywords: the anomalous magnetic moment, electron, muon, tauon, the fine-structure constant, 2π-e formula, elements, the standard model, elementary particles.

1. Introduction

In our previous paper[1], based on Schwinger's original formula[2] between the anomalous magnetic moment of electron and the fine-structure constant and our formulas such as 2π-e formula and the formulas of the fine-structure constant, we constructed two sets of formulas of the anomalous magnetic moment of electron, muon and tauon as follows.

$2\pi - e$ formula:

$$2\pi = \left(\frac{e}{e^{\gamma_c}}\right)^2 = e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots$$

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

Formulas of the fine-structure constant:

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

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

Formulas of the anomalous magnetic moment of electron, muon and tauon:

Schwinger formula (1948): $a_e \approx \frac{\alpha}{2\pi}$

Set 1:

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

$= 0.00115965218134971 \quad (2021/6/6)$

$$a_\mu = \frac{\alpha_2\gamma_\mu}{(2\pi)_{Chen-109}} = \frac{13\cdot(2\pi)_{Chen-278}}{100\cdot(2\pi)_{Chen-109}} \frac{(1+\frac{1}{25\cdot 11\cdot 47\cdot 109})(1+\frac{1}{5\cdot 37})}{112-\frac{1}{64\cdot 3\cdot 29}}$$

$= 0.00116592057152 \quad (2021/6/13)$

$$a_\tau = \frac{\alpha_2\gamma_\tau}{(2\pi)_{Chen-109}} = \frac{13\cdot(2\pi)_{Chen-278}}{100\cdot(2\pi)_{Chen-109}} \frac{(1+\frac{1}{25\cdot 11\cdot 47\cdot 109})(1+\frac{1}{5\cdot 13})}{(112-\frac{1}{64\cdot 3\cdot 29})}$$

$= 0.00117749298414 \quad (2021/6/17)$

Set 2:

$$a_e = \frac{\alpha_2\gamma_e}{(2\pi)_{Chen-109}} = \frac{13(2\pi)_{Chen-278}}{100(2\pi)_{Chen-109}} \frac{1+\frac{1}{3\cdot 47\cdot 73\cdot 137}}{112-\frac{1}{64\cdot 3\cdot 29}}$$

$= 0.00115965218058153 \quad (2023/3/7)$

$$a_\mu = \frac{\alpha_2 \gamma_\mu}{(2\pi)_{Chen-109}} = \frac{13\cdot(2\pi)_{Chen-278}}{100\cdot(2\pi)_{Chen-109}} \frac{(1+\frac{1}{3\cdot 47\cdot 73\cdot 137})(1+\frac{1}{5\cdot 37})}{112-\frac{1}{64\cdot 3\cdot 29}}$$

$$= 0.00116592057075 \quad (2023/3/10)$$

$$a_\tau = \frac{\alpha_2 \gamma_\tau}{(2\pi)_{Chen-109}} = \frac{13\cdot(2\pi)_{Chen-278}}{100\cdot(2\pi)_{Chen-109}} \frac{(1+\frac{1}{3\cdot 47\cdot 73\cdot 137})(1+\frac{1}{6\cdot 11})}{112-\frac{1}{64\cdot 3\cdot 29}}$$

$$= 0.00117722266817 \quad (2023/3/10)$$

In this paper, we will give a new formula of the anomalous magnetic moment of tauon and determine which one of the above two sets of formulas of the anomalous magnetic moment of electron, muon and tauon is more reasonable and should be the final set.

2. A New Formula of the Anomalous Magnetic Moment of Tauon

Based on the above formulas, we construct a new and more resonable formula of the anomalous magnetic moment of tauon as follows.

$$a_\tau = \frac{\alpha_2 \gamma_1 \gamma_2 \gamma_3}{(2\pi)_{Chen-109}} = \frac{13\cdot(2\pi)_{Chen-278}}{100\cdot(2\pi)_{Chen-109}} \frac{(1+\frac{1}{3\cdot 47\cdot 73\cdot 137})(1+\frac{1}{5\cdot 37})(1+\frac{1}{103})}{112-\frac{1}{64\cdot 3\cdot 29}}$$

$$= 0.00117724019 \quad (2023/8/14)$$

3. The Final Formulas of the Anomalous Magnetic Moment of Electron, Muon and Tauon

With the above stated more reasonable formula of the anomalous magnetic moment of tauon, the final formulas of the anomalous magnetic moment of electron, muon and tauon were determined and listed along with their related formulas as follows. And their reasonability could be confirmed by their relationships with nuclides[1, 3-11].

$2\pi - e$ formula:

$$2\pi = (\frac{e}{e^{\gamma_c}})^2 = e^2 \frac{e^2}{(\frac{2}{1})^3} \frac{e^2}{(\frac{3}{2})^5} \frac{e^2}{(\frac{4}{3})^7} \cdots$$

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

Formulas of the fine-structure constant:

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

$$\alpha_2=\frac{13\cdot(2\pi)_{Chen-278}}{100}\frac{1}{112-\frac{1}{64\cdot3\cdot29}}=1/137.035999111818$$

Formulas of the speed of light in atomic units

$$c_{au}=\frac{c}{v_e}=\frac{1}{\alpha_c}=\frac{1}{\sqrt{\alpha_1\alpha_2}}$$

$$=\sqrt{112\times(168-\frac{1}{3}+\frac{1}{12\cdot47}-\frac{1}{14\cdot112\cdot(2\cdot173+1)})}=137.035999074626$$

Formulas of the anomalous magnetic moment of electron, muon and tauon:

Schwinger formula (1947): $a_e\approx\frac{\alpha}{2\pi}$

$$a_e=\frac{\alpha_2\gamma_1}{(2\pi)_{Chen-109}}=\frac{13(2\pi)_{Chen-278}}{100(2\pi)_{Chen-109}}\frac{1+\frac{1}{3\cdot47\cdot73\cdot137}}{112-\frac{1}{64\cdot3\cdot29}}$$

$$=0.00115965218058153\quad(2021/6/6,\ 2023/3/7)$$

$$a_\mu=\frac{\alpha_2\gamma_1\gamma_2}{(2\pi)_{Chen-109}}=\frac{13(2\pi)_{Chen-278}}{100(2\pi)_{Chen-109}}\frac{(1+\frac{1}{3\cdot47\cdot73\cdot137})(1+\frac{1}{5\cdot37})}{112-\frac{1}{64\cdot3\cdot29}}$$

$$=0.00116592057\quad(2021/6/13,\ 2023/3/10)$$

$$a_\tau=\frac{\alpha_2\gamma_1\gamma_2\gamma_3}{(2\pi)_{Chen-109}}=\frac{13(2\pi)_{Chen-278}}{100(2\pi)_{Chen-109}}\frac{(1+\frac{1}{3\cdot47\cdot73\cdot137})(1+\frac{1}{5\cdot37})(1+\frac{1}{103})}{112-\frac{1}{64\cdot3\cdot29}}$$

$$=0.00117724019\quad(2021/6/17,\ 2023/3/10,\ 2023/8/14)$$

Other formulas such as:

$141+173=314,\ 141=3\cdot47,\ 314=2\cdot157,\ 68=136/2,\ 69=138/2,\ \cdots$

Relationships of the above formulas with nuclides:

$^{14,15}_{7}N_{7,8}$ $^{27}_{13}Al_{14}$ $^{28-30}_{14}Si_{14-16}$ $^{47,48,50}_{22}Ti_{25,26,28}$ $^{54,56,58}_{26}Fe_{28,30,32}$ $^{58,60,64}_{28}Ni_{30,32,36}$ $^{63,65}_{29}Cu_{34,36}$

$^{73,74}_{32}Ge_{41,42}$ $^{82,83,84}_{36}Kr_{46,47,48}$ $^{85,87}_{37}Rb_{48,50}$ $^{100}_{44}Ru_{56}$ $^{103}_{45}Rh_{58}$ $^{107,109}_{47}Ag_{60,62}$ $^{111,112}_{48}Cd_{63,64}$

$^{112,114,116,118,119,120}_{50}Sn_{62,64,66,68,69,70}$ $^{125,126}_{52}Te_{73,74}$ $^{136,137,138}_{56}Ba_{80,81,82}$ $^{140,142}_{58}Ce_{82,84}$ $^{141}_{59}\mathrm{Pr}_{82}$

$^{145,146}_{61}Pm^{*}_{84,85}$ $^{157,158}_{64}Gd_{93,94}$ $^{168}_{68}Er_{100}$ $^{169}_{69}Tm_{100}$ $^{173}_{70}Yb_{103}$ $^{180,181}_{73}Ta_{107,108}$ $^{182-184,186}_{74}W_{108-110,112}$

$^{5\cdot37,187}_{75}\mathrm{Re}_{110,112}$ $^{4\cdot47,192}_{76}Os_{112,116}$ $^{208}_{82}Pt_{126}$ $^{209}_{83}Bi^{*}_{126}$ $^{209}_{84}Po^{*}_{125}$ $^{210,211}_{85}At^{*}_{125,126}$ $^{222}_{86}Rn^{*}_{136}$

$^{223,224}_{87}Fr^{*}_{136,137}$ $^{226}_{88}Ra^{*}_{138}$ $^{227}_{89}Ac^{*}_{138}$ $^{8\cdot29}_{90}Th^{*}_{142}$ $^{231,8\cdot29}_{91}Pa^{*}_{140,141}$ $^{235,238}_{92}U^{*}_{143,146}$ $^{239,240}_{94}Pu^{*}_{145,146}$

$$ {}^{257}_{100}Fm^{*}_{157} \quad {}^{264,265}_{103}Lr^{*}_{161,162} \quad {}^{274}_{107}Bh^{*}_{167} \quad {}^{276}_{108}Hs^{*}_{168} \quad {}^{278}_{109}Mt^{*}_{169} \quad {}^{285}_{112}Cn^{*}_{173} \quad {}^{310,312}_{125}Ch^{ie}_{185,187} \quad {}^{2\cdot157}_{126}Ch^{ie}_{4\cdot47} $$

$$ {}^{344,2\cdot173,12\cdot29}_{136,137,138}Fy^{ie}_{208,209,210} \quad {}^{354}_{141}Ch^{ie}_{213} \quad {}^{370}_{146}Ch^{ie}_{224} \quad {}^{400}_{157}Ch^{ie}_{243} \quad {}^{420}_{168}Ch^{ie}_{252} \quad {}^{426}_{169}Ch^{ie}_{257} \quad {}^{437,6\cdot73}_{173}Ch^{ie}_{264,265} $$

4. Comparison of Theoretical and Experimental Values of a_e, a_μ and a_τ

With the values given by the above final formulas and the theoretical and experimental values reported in literatures, we give their comparison in **Table 1**.

Table 1. Comparison of theoretical and experimental values of a_e, a_μ and a_τ.

Lepton	Calculated a^{SM} By Standard Model	Calculated a^{TC} By Theory of Chirality	Measured a^{EXP} By Experiment	$(a^{SM}-a^{TC})/a^{TC}$
e	0.001159652181606(23)[12]	0.00115965218058153[1]	0.00115965218059(13)[13]	8.8×10^{-10}
μ	0.00116591810(43)[14]	0.00116592057[1]	0.00116592040(54)[15] 0.00116592057(25)[16]	-2.1×10^{-6}
τ	0.00117721(5)[17]	0.00117724019	-0.052–0.013[18]	-2.6×10^{-5}

Note: Lifetime of tauon is very short, so it is quite difficult to measure a_τ with ordinary spin precession experiments[18].

In **Table 1**, the calculated value of the anomalous magnetic moment of muon by our theory (Theory of Chirality[6]) was 0.00116590057 (2021/6/13 and 2023/3/10), and it was perfectly consistent with the measurement result announced by Fermilab Muon g-2 Collaboration on 2023/8/10 which was 0.00116590057(25) based on the data from their experiment Run-2/3.

5. Prediction to Fermilab's Result Based on the Data from it Experiment Run-4

Based on our formulas and calculations, we here give prediction to Fermilab muon g-2 collaboration's measurement result based on the data from its experiment Run-4 which should be announced in 2025. The Fermilab's next measurement of the anomalous magnetic moment of muon should be very closed to 0.00116592057(15).

6. Correlation of 2π-e Formula to Elements

Based on our formulas listed above, we could conclude that there should be proper correlation between 2π-e formula and the most stable nuclide of some terminal elements as follows.

$$ (2\pi)_{Chen-112} \iff {}^{285}_{112}Cn^{*}_{173} $$

$$ (2\pi)_{Chen-109} + (2\pi)_{Chen-278} \iff {}^{278}_{109}Mt^{*}_{169} $$

Also suppose: $(2\pi)_{Chen-1} \iff {}^{1}_{1}H_{1}$, $(2\pi)_{Chen-4} \iff {}^{4}_{2}He_{2}$

And according to our theories, the natural terminal of elements is $_{112}$Cn, so 2π-e formula should be correlated to elements at starting points and terminal points, or 2π-e formula flies over the elements (**Fig. 1**).

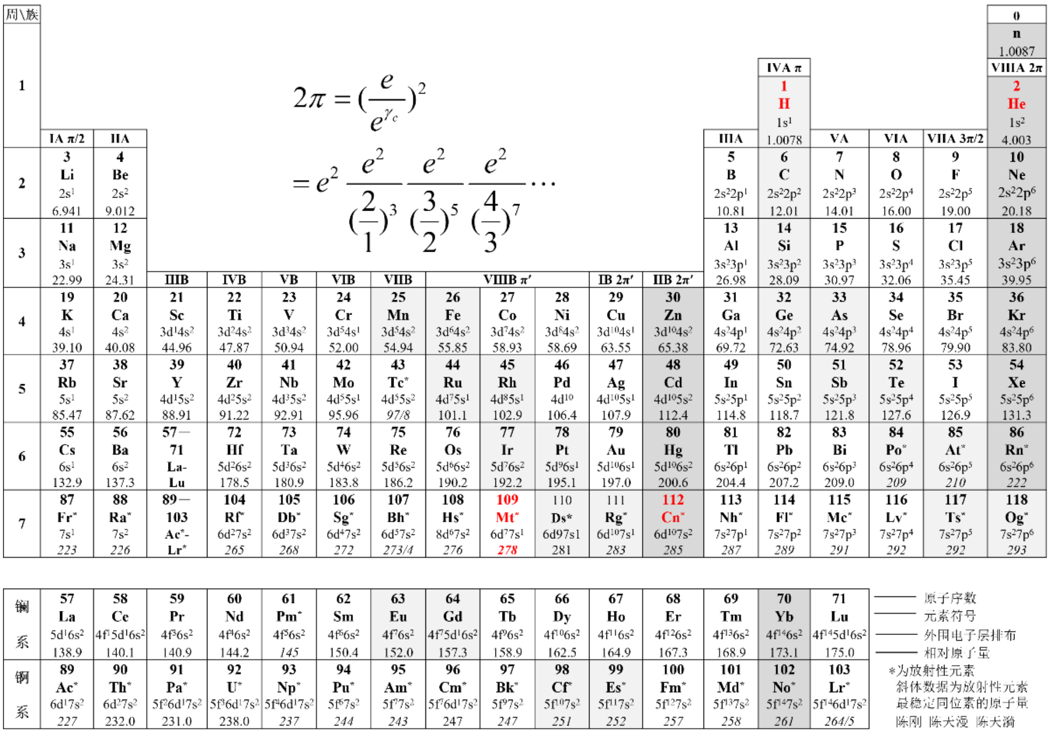

Figure 1. Correlation between 2π-e formula and elements

We can make an analogy. From Chengdu to Shanghai, we can travel by train going through the lands, and we can also take airplane flying over the lands. Chengdu and Shanghai have two airports respectively. This is just like the correlation between 2π-e formula and elements, or there are similar effects/phenomena in ordinary world.

7. Correlation of 2π-e Formula to Elementary Particles

According to the formulas of the anomalous magnetic moment of electron, muon and tauon, there should also be proper correlation between 2π-e formula and the standard model of particle physics (SM), for example, $(2\pi\text{-e})_{Chen\text{-}109}$ is almost equivalent to the effect of SM in calculation of the anomalous magnetic moment of electron, muon and tauon as follows. And if 2π-e Formula is correlated to SM, it should also be correlated to the elementary particles.

$$a_{e/} = \frac{\alpha_2 \gamma_1}{(2\pi)_{Chen-109}}, \quad a_\mu = \frac{\alpha_2 \gamma_1 \gamma_2}{(2\pi)_{Chen-109}}, \quad a_\tau = \frac{\alpha_2 \gamma_1 \gamma_2 \gamma_3}{(2\pi)_{Chen-109}}$$

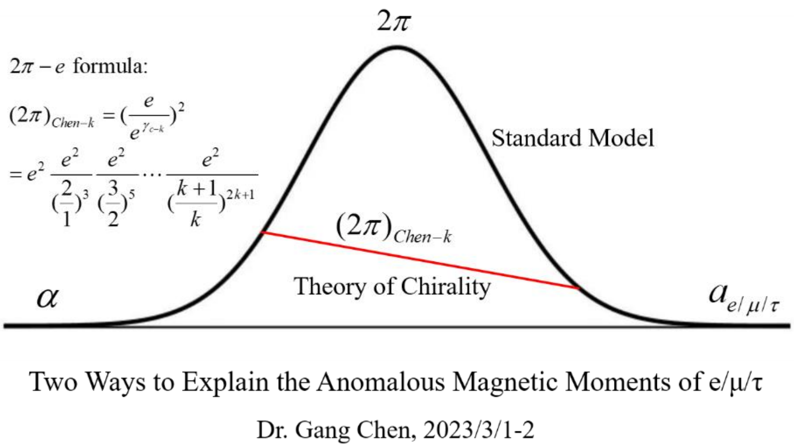

Figure 2. Correlation of 2π-e formula with the standard model of particle physics

8. Prediction of the Completeness of the Standard Model of Particle Physics

we predict that the standard model of particle physics should be complete because our theory of chirality is equivalent to the standard model in calculating the anomalous magnetic moment of electron, muon and tauon. The two ways should have the same start point and the terminal point, one goes through a tunnel and one climbs over a mountain.

9. Discussion and Conclusion

2π-e formula is correlated to elements and the elementary particles, so it should be the real God formula and the most beautiful scientific formula.

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Appendix I: Research History

Work	Page	Date	Location
Preparing this paper (v1)	6	2023/8/25-26	Hanyuan, Sichuan
Preparing this paper (v2)	8	2023/8/25-31	Hanyuan, Sichuan

Note: Date was recorded according to Beijing Time.