Cause Analysis of Magnetic Moment Anomaly of Electron Family ---- Divergence between Electromagnetic Force and Weak Nuclear Force

Huang Zhengdong

Hubei University Of Technology, Wu Han

Abstract: The paper aimed to analyze the decay mode of 253 kinds of electron particles and one kind of collision reaction in order to discover the objective existence of the decay state of the electron particles. Meanwhile, the paper also intended to research the cause of the magnetic moment anomaly of the electron to obtain the theoretical value of g, and this value was compared with the experimental value: the two values have 12 significant figures as the same, and the error is within 5.3E-13. Furthermore, the proposed method was compared with QED method for advantage and disadvantage analysis in the aspects of action type, theoretical accuracy of magnetic moment anomaly, particle state, basic reaction type, potential energy form, formula for magnetic moment anomaly of electron and seven major items of detail. The proposed method is superior in all above aspects and can effectively avoid the three problems exposed in QED method, namely: intrinsic property explanation by external factors, inconsistence between μ theoretical value and experimental value and point state difficulty, so the proposed method

becomes the most reasonable theory for explaining the magnetic moment anomaly of electron.

Keywords: magnetic moment Anomaly ; Lande g factor; Electromagnetic force; weak nuclear force

I. Introduction

I believe the wrong explanation for the cause of the magnetic moment anomaly of electron in the quantum electrodynamics (hereinafter referred to as QED) for the following three reasons:

1.The intrinsic property is determined by internal factors: as discovered in the present stage, the electron particles may participate in the action of three basic forces [1], wherein the three forces are respectively gravitational force, weak nuclear force and electromagnetic force. The gravitational force and the weak nuclear force can act on the particles themselves, so they belong to the internal force scope. Since there are many examples of the gravitational force, it will not be repeatedly described in the paper. The weak nuclear force dominates the decay action of some particles, and the decay mode [1] which can maximally reflect the intrinsic force property is $\mu \to \overline{\upsilon}_\mu + \overline{\upsilon}_e + e$, $\tau \to \overline{\upsilon}_\tau + \overline{\upsilon}_e + e$; the electromagnetic force can only act between the electric charges rather than the electric charges themselves, so it is called as external force. For the present subject, how about the anomaly cause of the magnetic moment as the intrinsic property of the particles?

Firstly, we need to understand that the evaluation standard of the magnetic moment of electron is Bohr magneton [2], and any deviation from the Bohr magneton can be regarded as anomaly. Specifically, the Gaussian Bohr magneton is introduced in the paper and extended to the whole electron family.

$$\mu_B = \frac{e\hbar}{2m_i c}, \quad i = e, \mu, \tau \qquad (1)$$

In 1947, Rabi, Nafe and Nelson researched the hyperfine structure of hydrogen and deuterium [3], thus experimentally showing the inconsistence between the hyperfine structure of the hydrogen atom and Dirac theory [4]. Accordingly, Kush and Foley made a decisive experiment to accurately prove that g factor of electron is not equal to 2; in other words, a weak deviation exists between the magnetic moment of electron and the Bohr magnetic moment, namely: electron has magnetic moment anomaly.

The magnetic moment anomaly of electron has been explained, so we will talk about the problems regarding QED [4] ~ [21]. Lamb displacement [5] and magnetic moment anomaly of electron are regarded as the two experiment supports of the quantum electrodynamics, but the two phenomena have different research subjects. Specifically, the research subject of the former one is proton and electron, while the research subject of the latter one is electron itself. The above two phenomena are regarded as the result of the electromagnetic action in the quantum electrodynamics; it is not improper to explain the cause for the phenomenon formation between two charged particles by the electromagnetic action, but the latter one only has a single electric charge, so the action mode thereof is doubtful.

As explained in QED, the interaction between the electron and the photon [4] ~ [21] is the simplest photon - electron conversion model as follows:

$$e \to e + \gamma \to e + e^{+} + e \to 2\gamma + e \to e$$

The above model shows a circular reaction. As simply described, an electron radiates a photon, then the photon decays into a positive and negative electron pair, then the positive and negative electron pair annihilates into a photon, and finally the electron and the photon combine into a new electron. In fact, the process is more complicated in QED, and it is believed that the electron and the photon in each step of above formula can infinitely decay, so the calculation method is abnormally tedious.

Ultimately, the photon - electron conversion model represents an action between electrons and external particles, and as mentioned in above opinion, the internal magnetic moment of electron can be influenced by external factors. This opinion violates the basic logical relationship, because the magnetic moment as the intrinsic property of electron is a constant for the observer and is not changed along with the external factors. Therefore, it is wrong to take the external factor as the initiator for the magnetic moment anomaly of electron in the quantum electrodynamics.

The intrinsic property of the electron particles is determined by the internal force. As firmly believed, the external force cannot influence the intrinsic property of the electron particles, so the force which can influence the intrinsic property is nothing more than the gravitational force and the weak nuclear force. Since the strength of the gravitational force is ignored microscopically, the weak nuclear force is exactly the promoter for magnetic moment anomaly of electron.

2. The theoretical value of μ magnetic moment, calculated by QED, is inconsistent with the experimental value. The newest μ magnetic moment anomaly value calculated according to QED theory is [22][1].

$$a_{\mu}^{SM}=0.00116591763(46) \quad (2)$$

The experimental value of the newest μ abnormal dipole magnetic moment is [1].

$$a_{\mu}^{\exp}=0.00116592089\ (54)(33) \quad (3)$$

The following formula can be obtained by the subtraction of the above two formulae:

$$a_{\mu}^{\exp}-a_{\mu}^{SM}=326(100)(33)\times 10^{-11} \quad (4)$$

Obviously, QED prediction is significantly deviated from the experimentally measured value and is beyond the error range, thus indicating the inapplicability of QED theory in solving the μ magnetic moment anomaly problems. I attempted to solve the magnetic moment anomaly of electron from the aspect of the weak nuclear force and obtained certain achievements. The method for solving the magnetic moment anomaly of electron through the weak nuclear force is called as the weak force potential method, which is corresponding to the QED method. The QED theoretical values [23][24][25], the experimental value [1] and the theoretical values of the weak force potential method are statistically concluded in the following table:

Tab.1 Statistical Table of Theoretical Value and Experimental Value of Magnetic Moment Anomaly of Electron			
Name of Particle	QED Theoretical Value	Experimental Value	Theoretical Value of Weak Force Potential Method
e	$0.00115965218164 3(25)(23)(16)(763)$	$0.0011596521\ 8091(26)$	$0.0011596521\ 811672$
μ	$0.0011659176\ 3(46)$	$0.00116592089(54)(33)$	$0.0011659209\ 0879$
τ	$0.00117721(5)$	$(-0.052, 0.013)$	$0.0011654642\ 0407$

Note: In above table, the theoretical value of the weak force potential method is calculated according to the intermediate value of the experiment values, without considering the theoretical error.

Obviously, the theoretical value of the weak force potential is basically as the same as the experimental value, but the theoretical value of the μ magnetic moment, calculated by QED, is significantly different from the experimental value. Therefore, in the aspect of accuracy, the weak force potential method is better.

3. Point state difficulty: the weak force potential method aims to research the influence of the weak nuclear force decay mode on the magnetic moment of electron. Firstly, the μ decay modes and the τ decay modes [1] collected by PDG up to the year of 2017 are as follows (shown in Tab.2 and Tab.3):

Tab.2 Summary of μ Decay Modes

μ^- DECAY MODES

μ^+ modes are charge conjugates of the modes below.

	Mode		Fraction (Γ_i/Γ)		Confidence level
Γ_1	$e^- \overline{\nu}_e \nu_\mu$		$\approx 100\%$		
Γ_2	$e^- \overline{\nu}_e \nu_\mu \gamma$		[a] $(6.0 \pm 0.5) \times 10^{-8}$		
Γ_3	$e^- \overline{\nu}_e \nu_\mu e^+ e^-$		[b] $(3.4 \pm 0.4) \times 10^{-5}$		
	Lepton Family number (*LF*) violating modes				
Γ_4	$e^- \nu_e \overline{\nu}_\mu$	*LF*	[c] < 1.2	%	90%
Γ_5	$e^- \gamma$	*LF*	< 4.2	$\times 10^{-13}$	90%
Γ_6	$e^- e^+ e^-$	*LF*	< 1.0	$\times 10^{-12}$	90%
Γ_7	$e^- 2\gamma$	*LF*	< 7.2	$\times 10^{-11}$	90%

[a] This only includes events with the γ energy > 10 MeV. Since the $e^- \overline{\nu}_e \nu_\mu$ and $e^- \overline{\nu}_e \nu_\mu \gamma$ modes cannot be clearly separated, we regard the latter mode as a subset of the former.

[b] See the Particle Listings below for the energy limits used in this measurement.

[c] A test of additive vs. multiplicative lepton family number conservation.

In Tab.2, 7 kinds of decay modes are statistically collected, wherein the fourth to the seventh decay modes have unclear branching ratio and shall be excluded, so the models with practical research value only include the first to the third decay modes, namely three kinds of effective decay modes in total.

Tab.3 Summary of τ Decay Modes

τ^- DECAY MODES

τ^+ modes are charge conjugates of the modes below. "$h^\pm$" stands for $\pi^\pm$ or $K^\pm$. "ℓ" stands for e or μ. "Neutrals" stands for γ's and/or π^0's.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Modes with one charged particle			
Γ_1	particle$^-$ ≥ 0 neutrals $\geq 0K^0\nu_\tau$ ("1-prong")		(85.24 ± 0.06) %	
Γ_2	particle$^-$ ≥ 0 neutrals $\geq 0K_L^0\nu_\tau$		(84.58 ± 0.06) %	
Γ_3	$\mu^-\overline{\nu}_\mu\nu_\tau$	[a]	(17.39 ± 0.04) %	
Γ_4	$\mu^-\overline{\nu}_\mu\nu_\tau\gamma$	[b]	$(3.68 \pm 0.10) \times 10^{-3}$	
Γ_5	$e^-\overline{\nu}_e\nu_\tau$	[a]	(17.82 ± 0.04) %	
Γ_6	$e^-\overline{\nu}_e\nu_\tau\gamma$	[b]	(1.84 ± 0.05) %	
Γ_7	$h^- \geq 0K_L^0\ \nu_\tau$		(12.03 ± 0.05) %	
Γ_8	$h^-\nu_\tau$		(11.51 ± 0.05) %	
Γ_9	$\pi^-\nu_\tau$	[a]	(10.82 ± 0.05) %	
Γ_{10}	$K^-\nu_\tau$	[a]	$(6.96 \pm 0.10) \times 10^{-3}$	
Γ_{11}	$h^- \geq 1$ neutrals ν_τ		(37.00 ± 0.09) %	
Γ_{12}	$h^- \geq 1\pi^0\nu_\tau$ (ex.K^0)		(36.51 ± 0.09) %	
Γ_{13}	$h^-\pi^0\nu_\tau$		(25.93 ± 0.09) %	
Γ_{14}	$\pi^-\pi^0\nu_\tau$	[a]	(25.49 ± 0.09) %	
Γ_{15}	$\pi^-\pi^0$ non-$\rho(770)\nu_\tau$		$(3.0 \pm 3.2) \times 10^{-3}$	
Γ_{16}	$K^-\pi^0\nu_\tau$	[a]	$(4.33 \pm 0.15) \times 10^{-3}$	
Γ_{17}	$h^- \geq 2\pi^0\nu_\tau$		(10.81 ± 0.09) %	
Γ_{18}	$h^-2\pi^0\nu_\tau$		(9.48 ± 0.10) %	
Γ_{19}	$h^-2\pi^0\nu_\tau$ (ex.K^0)		(9.32 ± 0.10) %	
Γ_{20}	$\pi^-2\pi^0\nu_\tau$ (ex.K^0)	[a]	(9.26 ± 0.10) %	
Γ_{21}	$\pi^-2\pi^0\nu_\tau$ (ex.K^0), scalar		$< 9 \times 10^{-3}$	CL=95%
Γ_{22}	$\pi^-2\pi^0\nu_\tau$ (ex.K^0), vector		$< 7 \times 10^{-3}$	CL=95%
Γ_{23}	$K^-2\pi^0\nu_\tau$ (ex.K^0)	[a]	$(6.5 \pm 2.2) \times 10^{-4}$	
Γ_{24}	$h^- \geq 3\pi^0\nu_\tau$		(1.34 ± 0.07) %	
Γ_{25}	$h^- \geq 3\pi^0\nu_\tau$ (ex. K^0)		(1.25 ± 0.07) %	
Γ_{26}	$h^-3\pi^0\nu_\tau$		(1.18 ± 0.07) %	
Γ_{27}	$\pi^-3\pi^0\nu_\tau$ (ex.K^0)	[a]	(1.04 ± 0.07) %	
Γ_{28}	$K^-3\pi^0\nu_\tau$ (ex.K^0, η)	[a]	$(4.8 \pm 2.1) \times 10^{-4}$	
Γ_{29}	$h^-4\pi^0\nu_\tau$ (ex.K^0)		$(1.6 \pm 0.4) \times 10^{-3}$	
Γ_{30}	$h^-4\pi^0\nu_\tau$ (ex.K^0,η)	[a]	$(1.1 \pm 0.4) \times 10^{-3}$	
Γ_{31}	$a_1(1260)\nu_\tau \to \pi^-\gamma\nu_\tau$		$(3.8 \pm 1.5) \times 10^{-4}$	
Γ_{32}	$K^- \geq 0\pi^0 \geq 0K^0 \geq 0\gamma\ \nu_\tau$		(1.552 ± 0.029) %	
Γ_{33}	$K^- \geq 1$ (π^0 or K^0 or γ) ν_τ		$(8.59 \pm 0.28) \times 10^{-3}$	

Modes with K^0's

Γ_{34}	K_S^0 (particles)$^- \nu_\tau$		$(9.44 \pm 0.28) \times 10^{-3}$	
Γ_{35}	$h^- \overline{K}^0 \nu_\tau$		$(9.87 \pm 0.14) \times 10^{-3}$	
Γ_{36}	$\pi^- \overline{K}^0 \nu_\tau$	[a]	$(8.40 \pm 0.14) \times 10^{-3}$	
Γ_{37}	$\pi^- \overline{K}^0$ (non-$K^*(892)^-$) ν_τ		$(5.4 \pm 2.1) \times 10^{-4}$	
Γ_{38}	$K^- K^0 \nu_\tau$	[a]	$(1.48 \pm 0.05) \times 10^{-3}$	
Γ_{39}	$K^- K^0 \geq 0\pi^0 \nu_\tau$		$(2.98 \pm 0.08) \times 10^{-3}$	
Γ_{40}	$h^- \overline{K}^0 \pi^0 \nu_\tau$		$(5.32 \pm 0.13) \times 10^{-3}$	
Γ_{41}	$\pi^- \overline{K}^0 \pi^0 \nu_\tau$	[a]	$(3.82 \pm 0.13) \times 10^{-3}$	
Γ_{42}	$\overline{K}^0 \rho^- \nu_\tau$		$(2.2 \pm 0.5) \times 10^{-3}$	
Γ_{43}	$K^- K^0 \pi^0 \nu_\tau$	[a]	$(1.50 \pm 0.07) \times 10^{-3}$	
Γ_{44}	$\pi^- \overline{K}^0 \geq 1\pi^0 \nu_\tau$		$(4.08 \pm 0.25) \times 10^{-3}$	
Γ_{45}	$\pi^- \overline{K}^0 \pi^0 \pi^0 \nu_\tau$ (ex.K^0)	[a]	$(2.6 \pm 2.3) \times 10^{-4}$	
Γ_{46}	$K^- K^0 \pi^0 \pi^0 \nu_\tau$		$< 1.6 \times 10^{-4}$	CL=95%
Γ_{47}	$\pi^- K^0 \overline{K}^0 \nu_\tau$		$(1.55 \pm 0.24) \times 10^{-3}$	
Γ_{48}	$\pi^- K_S^0 K_S^0 \nu_\tau$	[a]	$(2.33 \pm 0.07) \times 10^{-4}$	
Γ_{49}	$\pi^- K_S^0 K_L^0 \nu_\tau$	[a]	$(1.08 \pm 0.24) \times 10^{-3}$	
Γ_{50}	$\pi^- K_L^0 K_L^0 \nu_\tau$		$(2.33 \pm 0.07) \times 10^{-4}$	
Γ_{51}	$\pi^- K^0 \overline{K}^0 \pi^0 \nu_\tau$		$(3.6 \pm 1.2) \times 10^{-4}$	
Γ_{52}	$\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	[a]	$(1.82 \pm 0.21) \times 10^{-5}$	
Γ_{53}	$K^{*-} K^0 \pi^0 \nu_\tau \to \pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$		$(1.08 \pm 0.21) \times 10^{-5}$	
Γ_{54}	$f_1(1285) \pi^- \nu_\tau \to \pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$		$(6.8 \pm 1.5) \times 10^{-6}$	
Γ_{55}	$f_1(1420) \pi^- \nu_\tau \to \pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$		$(2.4 \pm 0.8) \times 10^{-6}$	
Γ_{56}	$\pi^- K_S^0 K_L^0 \pi^0 \nu_\tau$	[a]	$(3.2 \pm 1.2) \times 10^{-4}$	
Γ_{57}	$\pi^- K_L^0 K_L^0 \pi^0 \nu_\tau$		$(1.82 \pm 0.21) \times 10^{-5}$	
Γ_{58}	$K^- K_S^0 K_S^0 \nu_\tau$		$< 6.3 \times 10^{-7}$	CL=90%
Γ_{59}	$K^- K_S^0 K_S^0 \pi^0 \nu_\tau$		$< 4.0 \times 10^{-7}$	CL=90%
Γ_{60}	$K^0 h^+ h^- h^- \geq 0$ neutrals ν_τ		$< 1.7 \times 10^{-3}$	CL=95%
Γ_{61}	$K^0 h^+ h^- h^- \nu_\tau$	[a]	$(2.5 \pm 2.0) \times 10^{-4}$	

Modes with three charged particles

Γ_{62}	$h^- h^- h^+ \geq 0$ neutrals $\geq 0 K_L^0 \nu_\tau$		(15.21 ± 0.06) %	
Γ_{63}	$h^- h^- h^+ \geq 0$ neutrals ν_τ (ex. $K_S^0 \to \pi^+ \pi^-$) ("3-prong")		(14.55 ± 0.06) %	
Γ_{64}	$h^- h^- h^+ \nu_\tau$		(9.80 ± 0.05) %	
Γ_{65}	$h^- h^- h^+ \nu_\tau$ (ex.K^0)		(9.46 ± 0.05) %	
Γ_{66}	$h^- h^- h^+ \nu_\tau$ (ex.K^0,ω)		(9.43 ± 0.05) %	
Γ_{67}	$\pi^- \pi^+ \pi^- \nu_\tau$		(9.31 ± 0.05) %	
Γ_{68}	$\pi^- \pi^+ \pi^- \nu_\tau$ (ex.K^0)		(9.02 ± 0.05) %	

Γ_{69}	$\pi^- \pi^+ \pi^- \nu_\tau$ (ex.K^0), non-axial vector		< 2.4	%	CL=95%
Γ_{70}	$\pi^- \pi^+ \pi^- \nu_\tau$ (ex.K^0,ω)	[a]	(8.99 $\pm$ 0.05) %		
Γ_{71}	$h^- h^- h^+ \geq 1$ neutrals ν_τ		(5.29 $\pm$ 0.05) %		
Γ_{72}	$h^- h^- h^+ \geq 1 \pi^0 \nu_\tau$ (ex. K^0)		(5.09 $\pm$ 0.05) %		
Γ_{73}	$h^- h^- h^+ \pi^0 \nu_\tau$		(4.76 $\pm$ 0.05) %		
Γ_{74}	$h^- h^- h^+ \pi^0 \nu_\tau$ (ex.K^0)		(4.57 $\pm$ 0.05) %		
Γ_{75}	$h^- h^- h^+ \pi^0 \nu_\tau$ (ex. K^0, ω)		(2.79 $\pm$ 0.07) %		
Γ_{76}	$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$		(4.62 $\pm$ 0.05) %		
Γ_{77}	$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0)		(4.49 $\pm$ 0.05) %		
Γ_{78}	$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0,ω)	[a]	(2.74 $\pm$ 0.07) %		
Γ_{79}	$h^- \rho \pi^0 \nu_\tau$				
Γ_{80}	$h^- \rho^+ h^- \nu_\tau$				
Γ_{81}	$h^- \rho^- h^+ \nu_\tau$				
Γ_{82}	$h^- h^- h^+ \geq 2\pi^0 \nu_\tau$ (ex. K^0)		(5.17 $\pm$ 0.31) $\times 10^{-3}$		
Γ_{83}	$h^- h^- h^+ 2\pi^0 \nu_\tau$		(5.05 $\pm$ 0.31) $\times 10^{-3}$		
Γ_{84}	$h^- h^- h^+ 2\pi^0 \nu_\tau$ (ex.K^0)		(4.95 $\pm$ 0.31) $\times 10^{-3}$		
Γ_{85}	$h^- h^- h^+ 2\pi^0 \nu_\tau$ (ex.K^0,ω,η)	[a]	(10 $\pm$ 4) $\times 10^{-4}$		
Γ_{86}	$h^- h^- h^+ 3\pi^0 \nu_\tau$		(2.12 $\pm$ 0.30) $\times 10^{-4}$		
Γ_{87}	$2\pi^- \pi^+ 3\pi^0 \nu_\tau$ (ex.K^0)		(1.94 $\pm$ 0.30) $\times 10^{-4}$		
Γ_{88}	$2\pi^- \pi^+ 3\pi^0 \nu_\tau$ (ex.K^0, η, $f_1(1285)$)		(1.7 $\pm$ 0.4) $\times 10^{-4}$		
Γ_{89}	$2\pi^- \pi^+ 3\pi^0 \nu_\tau$ (ex.K^0, η, ω, $f_1(1285)$)	[a]	(1.4 $\pm$ 2.7) $\times 10^{-5}$		
Γ_{90}	$K^- h^+ h^- \geq 0$ neutrals ν_τ		(6.29 $\pm$ 0.14) $\times 10^{-3}$		
Γ_{91}	$K^- h^+ \pi^- \nu_\tau$ (ex.K^0)		(4.37 $\pm$ 0.07) $\times 10^{-3}$		
Γ_{92}	$K^- h^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0)		(8.6 $\pm$ 1.2) $\times 10^{-4}$		
Γ_{93}	$K^- \pi^+ \pi^- \geq 0$ neutrals ν_τ		(4.77 $\pm$ 0.14) $\times 10^{-3}$		
Γ_{94}	$K^- \pi^+ \pi^- \geq 0\pi^0 \nu_\tau$ (ex.K^0)		(3.73 $\pm$ 0.13) $\times 10^{-3}$		
Γ_{95}	$K^- \pi^+ \pi^- \nu_\tau$		(3.45 $\pm$ 0.07) $\times 10^{-3}$		
Γ_{96}	$K^- \pi^+ \pi^- \nu_\tau$ (ex.K^0)		(2.93 $\pm$ 0.07) $\times 10^{-3}$		
Γ_{97}	$K^- \pi^+ \pi^- \nu_\tau$ (ex.K^0,ω)	[a]	(2.93 $\pm$ 0.07) $\times 10^{-3}$		
Γ_{98}	$K^- \rho^0 \nu_\tau \rightarrow K^- \pi^+ \pi^- \nu_\tau$		(1.4 $\pm$ 0.5) $\times 10^{-3}$		
Γ_{99}	$K^- \pi^+ \pi^- \pi^0 \nu_\tau$		(1.31 $\pm$ 0.12) $\times 10^{-3}$		
Γ_{100}	$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0)		(7.9 $\pm$ 1.2) $\times 10^{-4}$		
Γ_{101}	$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0,η)		(7.6 $\pm$ 1.2) $\times 10^{-4}$		
Γ_{102}	$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0,ω)		(3.7 $\pm$ 0.9) $\times 10^{-4}$		
Γ_{103}	$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex.K^0,ω,η)	[a]	(3.9 $\pm$ 1.4) $\times 10^{-4}$		
Γ_{104}	$K^- \pi^+ K^- \geq 0$ neut. ν_τ		< 9	$\times 10^{-4}$	CL=95%
Γ_{105}	$K^- K^+ \pi^- \geq 0$ neut. ν_τ		(1.496 $\pm$ 0.033) $\times 10^{-3}$		
Γ_{106}	$K^- K^+ \pi^- \nu_\tau$	[a]	(1.435 $\pm$ 0.027) $\times 10^{-3}$		
Γ_{107}	$K^- K^+ \pi^- \pi^0 \nu_\tau$	[a]	(6.1 $\pm$ 1.8) $\times 10^{-5}$		

Γ_{108}	$K^- K^+ K^- \nu_\tau$		$(2.2 \pm 0.8) \times 10^{-5}$		S=5.4
Γ_{109}	$K^- K^+ K^- \nu_\tau$ (ex. ϕ)		$< 2.5 \times 10^{-6}$		CL=90%
Γ_{110}	$K^- K^+ K^- \pi^0 \nu_\tau$		$< 4.8 \times 10^{-6}$		CL=90%
Γ_{111}	$\pi^- K^+ \pi^- \geq 0$ neut. ν_τ		$< 2.5 \times 10^{-3}$		CL=95%
Γ_{112}	$e^- e^- e^+ \overline{\nu}_e \nu_\tau$		$(2.8 \pm 1.5) \times 10^{-5}$		
Γ_{113}	$\mu^- e^- e^+ \overline{\nu}_\mu \nu_\tau$		$< 3.6 \times 10^{-5}$		CL=90%
	Modes with five charged particles				
Γ_{114}	$3h^- 2h^+ \geq 0$ neutrals ν_τ (ex. $K^0_S \to \pi^- \pi^+$) ("5-prong")		$(9.9 \pm 0.4) \times 10^{-4}$		
Γ_{115}	$3h^- 2h^+ \nu_\tau$ (ex.K^0)		$(8.22 \pm 0.32) \times 10^{-4}$		
Γ_{116}	$3\pi^- 2\pi^+ \nu_\tau$ (ex.K^0, ω)		$(8.21 \pm 0.31) \times 10^{-4}$		
Γ_{117}	$3\pi^- 2\pi^+ \nu_\tau$ (ex.K^0, ω, $f_1(1285)$)	[a]	$(7.69 \pm 0.30) \times 10^{-4}$		
Γ_{118}	$K^- 2\pi^- 2\pi^+ \nu_\tau$ (ex.K^0)	[a]	$(6 \pm 12) \times 10^{-7}$		
Γ_{119}	$K^+ 3\pi^- \pi^+ \nu_\tau$		$< 5.0 \times 10^{-6}$		CL=90%
Γ_{120}	$K^+ K^- 2\pi^- \pi^+ \nu_\tau$		$< 4.5 \times 10^{-7}$		CL=90%
Γ_{121}	$3h^- 2h^+ \pi^0 \nu_\tau$ (ex.K^0)		$(1.64 \pm 0.11) \times 10^{-4}$		
Γ_{122}	$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex.K^0)		$(1.62 \pm 0.11) \times 10^{-4}$		
Γ_{123}	$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex.K^0, η, $f_1(1285)$)		$(1.11 \pm 0.10) \times 10^{-4}$		
Γ_{124}	$3\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex.K^0, η, ω, $f_1(1285)$)	[a]	$(3.8 \pm 0.9) \times 10^{-5}$		
Γ_{125}	$K^- 2\pi^- 2\pi^+ \pi^0 \nu_\tau$ (ex.K^0)	[a]	$(1.1 \pm 0.6) \times 10^{-6}$		
Γ_{126}	$K^+ 3\pi^- \pi^+ \pi^0 \nu_\tau$		$< 8 \times 10^{-7}$		CL=90%
Γ_{127}	$3h^- 2h^+ 2\pi^0 \nu_\tau$		$< 3.4 \times 10^{-6}$		CL=90%
	Miscellaneous other allowed modes				
Γ_{128}	$(5\pi)^- \nu_\tau$		$(7.8 \pm 0.5) \times 10^{-3}$		
Γ_{129}	$4h^- 3h^+ \geq 0$ neutrals ν_τ ("7-prong")		$< 3.0 \times 10^{-7}$		CL=90%
Γ_{130}	$4h^- 3h^+ \nu_\tau$		$< 4.3 \times 10^{-7}$		CL=90%
Γ_{131}	$4h^- 3h^+ \pi^0 \nu_\tau$		$< 2.5 \times 10^{-7}$		CL=90%
Γ_{132}	$X^- (S{=}-1) \nu_\tau$		(2.92 ± 0.04) %		
Γ_{133}	$K^*(892)^- \geq 0$ neutrals $\geq 0 K^0_L \nu_\tau$		(1.42 ± 0.18) %		S=1.4
Γ_{134}	$K^*(892)^- \nu_\tau$		(1.20 ± 0.07) %		S=1.8
Γ_{135}	$K^*(892)^- \nu_\tau \to \pi^- \overline{K}^0 \nu_\tau$		$(7.83 \pm 0.26) \times 10^{-3}$		
Γ_{136}	$K^*(892)^0 K^- \geq 0$ neutrals ν_τ		$(3.2 \pm 1.4) \times 10^{-3}$		
Γ_{137}	$K^*(892)^0 K^- \nu_\tau$		$(2.1 \pm 0.4) \times 10^{-3}$		
Γ_{138}	$\overline{K}^*(892)^0 \pi^- \geq 0$ neutrals ν_τ		$(3.8 \pm 1.7) \times 10^{-3}$		
Γ_{139}	$\overline{K}^*(892)^0 \pi^- \nu_\tau$		$(2.2 \pm 0.5) \times 10^{-3}$		
Γ_{140}	$(\overline{K}^*(892)\pi)^- \nu_\tau \to \pi^- \overline{K}^0 \pi^0 \nu_\tau$		$(1.0 \pm 0.4) \times 10^{-3}$		

Γ_{141}	$K_1(1270)^- \nu_\tau$		$(4.7 \pm 1.1) \times 10^{-3}$	
Γ_{142}	$K_1(1400)^- \nu_\tau$		$(1.7 \pm 2.6) \times 10^{-3}$	S=1.7
Γ_{143}	$K^*(1410)^- \nu_\tau$		$(1.5 {}^{+1.4}_{-1.0}) \times 10^{-3}$	
Γ_{144}	$K_0^*(1430)^- \nu_\tau$		$< 5 \times 10^{-4}$	CL=95%
Γ_{145}	$K_2^*(1430)^- \nu_\tau$		$< 3 \times 10^{-3}$	CL=95%
Γ_{146}	$a_0(980)^- \geq 0$ neutrals ν_τ			
Γ_{147}	$\eta \pi^- \nu_\tau$		$< 9.9 \times 10^{-5}$	CL=95%
Γ_{148}	$\eta \pi^- \pi^0 \nu_\tau$	[a]	$(1.39 \pm 0.07) \times 10^{-3}$	
Γ_{149}	$\eta \pi^- \pi^0 \pi^0 \nu_\tau$	[a]	$(1.9 \pm 0.4) \times 10^{-4}$	
Γ_{150}	$\eta K^- \nu_\tau$	[a]	$(1.55 \pm 0.08) \times 10^{-4}$	
Γ_{151}	$\eta K^*(892)^- \nu_\tau$		$(1.38 \pm 0.15) \times 10^{-4}$	
Γ_{152}	$\eta K^- \pi^0 \nu_\tau$	[a]	$(4.8 \pm 1.2) \times 10^{-5}$	
Γ_{153}	$\eta K^- \pi^0 (\text{non-}K^*(892)) \nu_\tau$		$< 3.5 \times 10^{-5}$	CL=90%
Γ_{154}	$\eta \overline{K}^0 \pi^- \nu_\tau$	[a]	$(9.4 \pm 1.5) \times 10^{-5}$	
Γ_{155}	$\eta \overline{K}^0 \pi^- \pi^0 \nu_\tau$		$< 5.0 \times 10^{-5}$	CL=90%
Γ_{156}	$\eta K^- K^0 \nu_\tau$		$< 9.0 \times 10^{-6}$	CL=90%
Γ_{157}	$\eta \pi^+ \pi^- \pi^- \geq 0$ neutrals ν_τ		$< 3 \times 10^{-3}$	CL=90%
Γ_{158}	$\eta \pi^- \pi^+ \pi^- \nu_\tau (\text{ex.} K^0)$	[a]	$(2.19 \pm 0.13) \times 10^{-4}$	
Γ_{159}	$\eta \pi^- \pi^+ \pi^- \nu_\tau (\text{ex.} K^0, f_1(1285))$		$(9.9 \pm 1.6) \times 10^{-5}$	
Γ_{160}	$\eta a_1(1260)^- \nu_\tau \rightarrow \eta \pi^- \rho^0 \nu_\tau$		$< 3.9 \times 10^{-4}$	CL=90%
Γ_{161}	$\eta \eta \pi^- \nu_\tau$		$< 7.4 \times 10^{-6}$	CL=90%
Γ_{162}	$\eta \eta \pi^- \pi^0 \nu_\tau$		$< 2.0 \times 10^{-4}$	CL=95%
Γ_{163}	$\eta \eta K^- \nu_\tau$		$< 3.0 \times 10^{-6}$	CL=90%
Γ_{164}	$\eta'(958) \pi^- \nu_\tau$		$< 4.0 \times 10^{-6}$	CL=90%
Γ_{165}	$\eta'(958) \pi^- \pi^0 \nu_\tau$		$< 1.2 \times 10^{-5}$	CL=90%
Γ_{166}	$\eta'(958) K^- \nu_\tau$		$< 2.4 \times 10^{-6}$	CL=90%
Γ_{167}	$\phi \pi^- \nu_\tau$		$(3.4 \pm 0.6) \times 10^{-5}$	
Γ_{168}	$\phi K^- \nu_\tau$	[a]	$(4.4 \pm 1.6) \times 10^{-5}$	
Γ_{169}	$f_1(1285) \pi^- \nu_\tau$		$(3.9 \pm 0.5) \times 10^{-4}$	S=1.9
Γ_{170}	$f_1(1285) \pi^- \nu_\tau \rightarrow \eta \pi^- \pi^+ \pi^- \nu_\tau$		$(1.18 \pm 0.07) \times 10^{-4}$	S=1.3
Γ_{171}	$f_1(1285) \pi^- \nu_\tau \rightarrow 3\pi^- 2\pi^+ \nu_\tau$	[a]	$(5.2 \pm 0.4) \times 10^{-5}$	
Γ_{172}	$\pi(1300)^- \nu_\tau \rightarrow (\rho \pi)^- \nu_\tau \rightarrow (3\pi)^- \nu_\tau$		$< 1.0 \times 10^{-4}$	CL=90%
Γ_{173}	$\pi(1300)^- \nu_\tau \rightarrow ((\pi \pi)_{S-\text{wave}} \pi)^- \nu_\tau \rightarrow (3\pi)^- \nu_\tau$		$< 1.9 \times 10^{-4}$	CL=90%
Γ_{174}	$h^- \omega \geq 0$ neutrals ν_τ		(2.40 ± 0.08) %	
Γ_{175}	$h^- \omega \nu_\tau$		(1.99 ± 0.06) %	
Γ_{176}	$\pi^- \omega \nu_\tau$	[a]	(1.95 ± 0.06) %	
Γ_{177}	$K^- \omega \nu_\tau$	[a]	$(4.1 \pm 0.9) \times 10^{-4}$	
Γ_{178}	$h^- \omega \pi^0 \nu_\tau$	[a]	$(4.1 \pm 0.4) \times 10^{-3}$	
Γ_{179}	$h^- \omega 2\pi^0 \nu_\tau$		$(1.4 \pm 0.5) \times 10^{-4}$	

Γ_{180}	$\pi^- \omega 2\pi^0 \nu_\tau$	[a]	(7.1 $\pm$ 1.6)	$\times 10^{-5}$	
Γ_{181}	$h^- 2\omega \nu_\tau$		< 5.4	$\times 10^{-7}$	CL=90%
Γ_{182}	$2h^- h^+ \omega \nu_\tau$		(1.20 $\pm$ 0.22)	$\times 10^{-4}$	
Γ_{183}	$2\pi^- \pi^+ \omega \nu_\tau$ (ex.K^0)	[a]	(8.4 $\pm$ 0.6)	$\times 10^{-5}$	

Lepton Family number (*LF*), Lepton number (*L*), or Baryon number (*B*) violating modes

L means lepton number violation (*e.g.* $\tau^- \to e^+ \pi^- \pi^-$). Following common usage, *LF* means lepton family violation *and not* lepton number violation (*e.g.* $\tau^- \to e^- \pi^+ \pi^-$). *B* means baryon number violation.

Γ_{184}	$e^- \gamma$	*LF*	< 3.3	$\times 10^{-8}$	CL=90%
Γ_{185}	$\mu^- \gamma$	*LF*	< 4.4	$\times 10^{-8}$	CL=90%
Γ_{186}	$e^- \pi^0$	*LF*	< 8.0	$\times 10^{-8}$	CL=90%
Γ_{187}	$\mu^- \pi^0$	*LF*	< 1.1	$\times 10^{-7}$	CL=90%
Γ_{188}	$e^- K^0_S$	*LF*	< 2.6	$\times 10^{-8}$	CL=90%
Γ_{189}	$\mu^- K^0_S$	*LF*	< 2.3	$\times 10^{-8}$	CL=90%
Γ_{190}	$e^- \eta$	*LF*	< 9.2	$\times 10^{-8}$	CL=90%
Γ_{191}	$\mu^- \eta$	*LF*	< 6.5	$\times 10^{-8}$	CL=90%
Γ_{192}	$e^- \rho^0$	*LF*	< 1.8	$\times 10^{-8}$	CL=90%
Γ_{193}	$\mu^- \rho^0$	*LF*	< 1.2	$\times 10^{-8}$	CL=90%
Γ_{194}	$e^- \omega$	*LF*	< 4.8	$\times 10^{-8}$	CL=90%
Γ_{195}	$\mu^- \omega$	*LF*	< 4.7	$\times 10^{-8}$	CL=90%
Γ_{196}	$e^- K^*(892)^0$	*LF*	< 3.2	$\times 10^{-8}$	CL=90%
Γ_{197}	$\mu^- K^*(892)^0$	*LF*	< 5.9	$\times 10^{-8}$	CL=90%
Γ_{198}	$e^- \overline{K}^*(892)^0$	*LF*	< 3.4	$\times 10^{-8}$	CL=90%
Γ_{199}	$\mu^- \overline{K}^*(892)^0$	*LF*	< 7.0	$\times 10^{-8}$	CL=90%
Γ_{200}	$e^- \eta'(958)$	*LF*	< 1.6	$\times 10^{-7}$	CL=90%
Γ_{201}	$\mu^- \eta'(958)$	*LF*	< 1.3	$\times 10^{-7}$	CL=90%
Γ_{202}	$e^- f_0(980) \to e^- \pi^+ \pi^-$	*LF*	< 3.2	$\times 10^{-8}$	CL=90%
Γ_{203}	$\mu^- f_0(980) \to \mu^- \pi^+ \pi^-$	*LF*	< 3.4	$\times 10^{-8}$	CL=90%
Γ_{204}	$e^- \phi$	*LF*	< 3.1	$\times 10^{-8}$	CL=90%
Γ_{205}	$\mu^- \phi$	*LF*	< 8.4	$\times 10^{-8}$	CL=90%
Γ_{206}	$e^- e^+ e^-$	*LF*	< 2.7	$\times 10^{-8}$	CL=90%
Γ_{207}	$e^- \mu^+ \mu^-$	*LF*	< 2.7	$\times 10^{-8}$	CL=90%
Γ_{208}	$e^+ \mu^- \mu^-$	*LF*	< 1.7	$\times 10^{-8}$	CL=90%
Γ_{209}	$\mu^- e^+ e^-$	*LF*	< 1.8	$\times 10^{-8}$	CL=90%
Γ_{210}	$\mu^+ e^- e^-$	*LF*	< 1.5	$\times 10^{-8}$	CL=90%
Γ_{211}	$\mu^- \mu^+ \mu^-$	*LF*	< 2.1	$\times 10^{-8}$	CL=90%
Γ_{212}	$e^- \pi^+ \pi^-$	*LF*	< 2.3	$\times 10^{-8}$	CL=90%
Γ_{213}	$e^+ \pi^- \pi^-$	*L*	< 2.0	$\times 10^{-8}$	CL=90%
Γ_{214}	$\mu^- \pi^+ \pi^-$	*LF*	< 2.1	$\times 10^{-8}$	CL=90%
Γ_{215}	$\mu^+ \pi^- \pi^-$	*L*	< 3.9	$\times 10^{-8}$	CL=90%
Γ_{216}	$e^- \pi^+ K^-$	*LF*	< 3.7	$\times 10^{-8}$	CL=90%
Γ_{217}	$e^- \pi^- K^+$	*LF*	< 3.1	$\times 10^{-8}$	CL=90%

Γ_{218}	$e^+\pi^-K^-$	L	<	3.2	$\times 10^{-8}$	CL=90%
Γ_{219}	$e^-K^0_SK^0_S$	LF	<	7.1	$\times 10^{-8}$	CL=90%
Γ_{220}	$e^-K^+K^-$	LF	<	3.4	$\times 10^{-8}$	CL=90%
Γ_{221}	$e^+K^-K^-$	L	<	3.3	$\times 10^{-8}$	CL=90%
Γ_{222}	$\mu^-\pi^+K^-$	LF	<	8.6	$\times 10^{-8}$	CL=90%
Γ_{223}	$\mu^-\pi^-K^+$	LF	<	4.5	$\times 10^{-8}$	CL=90%
Γ_{224}	$\mu^+\pi^-K^-$	L	<	4.8	$\times 10^{-8}$	CL=90%
Γ_{225}	$\mu^-K^0_SK^0_S$	LF	<	8.0	$\times 10^{-8}$	CL=90%
Γ_{226}	$\mu^-K^+K^-$	LF	<	4.4	$\times 10^{-8}$	CL=90%
Γ_{227}	$\mu^+K^-K^-$	L	<	4.7	$\times 10^{-8}$	CL=90%
Γ_{228}	$e^-\pi^0\pi^0$	LF	<	6.5	$\times 10^{-6}$	CL=90%
Γ_{229}	$\mu^-\pi^0\pi^0$	LF	<	1.4	$\times 10^{-5}$	CL=90%
Γ_{230}	$e^-\eta\eta$	LF	<	3.5	$\times 10^{-5}$	CL=90%
Γ_{231}	$\mu^-\eta\eta$	LF	<	6.0	$\times 10^{-5}$	CL=90%
Γ_{232}	$e^-\pi^0\eta$	LF	<	2.4	$\times 10^{-5}$	CL=90%
Γ_{233}	$\mu^-\pi^0\eta$	LF	<	2.2	$\times 10^{-5}$	CL=90%
Γ_{234}	$p\mu^-\mu^-$	L,B	<	4.4	$\times 10^{-7}$	CL=90%
Γ_{235}	$\overline{p}\mu^+\mu^-$	L,B	<	3.3	$\times 10^{-7}$	CL=90%
Γ_{236}	$\overline{p}\gamma$	L,B	<	3.5	$\times 10^{-6}$	CL=90%
Γ_{237}	$\overline{p}\pi^0$	L,B	<	1.5	$\times 10^{-5}$	CL=90%
Γ_{238}	$\overline{p}2\pi^0$	L,B	<	3.3	$\times 10^{-5}$	CL=90%
Γ_{239}	$\overline{p}\eta$	L,B	<	8.9	$\times 10^{-6}$	CL=90%
Γ_{240}	$\overline{p}\pi^0\eta$	L,B	<	2.7	$\times 10^{-5}$	CL=90%
Γ_{241}	$\Lambda\pi^-$	L,B	<	7.2	$\times 10^{-8}$	CL=90%
Γ_{242}	$\overline{\Lambda}\pi^-$	L,B	<	1.4	$\times 10^{-7}$	CL=90%
Γ_{243}	e^- light boson	LF	<	2.7	$\times 10^{-3}$	CL=95%
Γ_{244}	μ^- light boson	LF	<	5	$\times 10^{-3}$	CL=95%

[a] Basis mode for the τ.

[b] See the Particle Listings below for the energy limits used in this measurement.

In Tab.3, 244 kinds of decay modes are statistically collected, wherein the 184th to the 244th decay modes have unclear branching ratio and shall be excluded, so the models with practical research value only include the first to the 183rd decay modes, namely 183 kinds of effective decay modes in total.

Through researching 186 kinds of effective decay modes (3 kinds of μ decay modes and 183 kinds of τ decay modes), we discover that all decay modes can emit a neutrino. Specifically, the decay mode and the branching ratio are as shown in the following table:

Tab.4 Summary of μ Decay Modes and τ Decay Modes	
Decay Mode	Fraction (Γi /Γ)
$\mu(\tau) \rightarrow \upsilon_{\mu(\tau)} + everything$	100%

The decayed particle and one decay product thereof have been confirmed; for tracing the source, when "everything" is only one particle, it is a meson. In such case, the simplest decay mode can be described as follows:

$$\mu(\tau) \rightarrow \upsilon_{\mu(\tau)} + X \quad (5)$$

Where X represents the meson;

Back to the research on the magnetic moment of electron problem, the magnetic moment anomaly of μ particle and τ particle is similarly associated with the actual decay modes thereof, and the decay state of the two particles can meet the simplest decay mode.

We can conclude the following rules: μ particle (or τ particle) always spontaneously emits one μ neutrino (or τ neutrino) to decay into the meson state with internal structure from the point state. Therein, we call the meson state as the decay state.

Electron is the smallest rest mass particle and cannot have the decay reaction. How to describe the decay state thereof? In order to ensure the complete consistence between the decay state of the electron and the decay states of μ particle and τ particle, we need to make the following hypothesis:

Electron always spontaneously emits an electron neutrino with negative mass to decay into the meson state with internal structure from the point state, namely: Formula (5) can be met:

Firstly, we need to prove the reciprocal decay reaction $n \Leftrightarrow \pi^- + p$. Step I, prove $n \rightarrow \pi^- + p$:

The weak force potential method is used for researching the two decay reactions which can generate the most electrons in the natural world, namely neutron and negative π meson decay reaction [1]. Specifically, the decay mode is as follows:

$$\begin{cases} n \rightarrow e + \overline{\upsilon}_e + p \\ \pi^- \rightarrow e + \overline{\upsilon}_e \end{cases} \qquad (6)$$

Since the products of the above two decay modes have electron and electron neutrino, we need to solve the first problem, namely: how to prove the chain reaction $n \rightarrow \pi^- + p \rightarrow e + \overline{\upsilon}_e + p$ of the neutron in the decay process?

In fact, the most direct evidence for proving the π meson generation of the neutron in the decay process is the magnetic moment thereof. Therefore, we roughly research the magnetic moment anomaly of the neutron in this part.

Theoretically, the electric charges carried by the neutron is 0, so the spin magnetic moment thereof is also 0. But the magnetic moment of the neutron, obtained in the experiment, is not zero [1].

$$\mu_n^{\exp} = -1.91304273\ (45)\mu_N \qquad (7)$$

I have discussed in the paper ----- *A strong force potential formula and the classification of the strong interaction* [26] that the neutron internally has "a d quark with two electric charges of - 1/3 (in original paper, it is a u quark with two electric charges of 2/3, and this has been corrected), and each quark may possibly decay into a particle with negative electric charge", and the process for the quark to absorb or emit the negative π meson is namely the strong nuclear force transmission process inside the neutron and the process for the quark to transit between the two spin states. Therefore, the probability for absorption and emission is 1/2.

$$n \Leftrightarrow \pi^{-} + p \tag{8}$$

Namely, the probability for the left and right states in above equation is 1/2. When the neutron is under the left state, the magnetic moment thereof is 0, because the total electric charge is 0; when the neutron is under the right state, the magnetic moment of the neutron is equal to the sum of the magnetic moment of the negative π meson and the magnetic moment of the proton. Since the magnetic moment of the neutron is equal to the superposition of the magnetic moments under the two states, we can obtain the following formula:

$$\begin{aligned}\bar{\mu}_n^{W-theo} &= \frac{\left(\bar{\mu}_{\pi^-} + \bar{\mu}_p\right)}{2} + \frac{0}{2} \\ &= \frac{1}{2} \times \left(g_{\pi^-} \frac{-e}{2m_{\pi^-}c} \vec{s}_{\pi^-} + g_p \frac{e}{2m_p c} \vec{s}_p \right)\end{aligned} \tag{9}$$

The following formula is put in above formula:

$$\begin{cases} g_{\pi^-} = 2 \\ g_p = 5.585694702(17) \end{cases} \tag{10}$$

The original formula is converted as follows:

$$
\begin{aligned}
&= \frac{1}{2} \times \left(2 \times \frac{e}{2m_{\pi^-}c} + 5.58694702 \times \frac{e}{2m_p c} \right) \\
&= \frac{1}{2} \times \left(-2 \times \frac{m_p}{m_{\pi^-}} + 5.58694702 \right) \times \frac{e}{2m_p c} \\
&= \frac{1}{2} \times \left(-2 \times \frac{938.2720813}{139.57061} + 5.58694702 \right) \times \frac{e}{2m_p c} \\
&= -1.9645443 \mu_N
\end{aligned} \tag{11}
$$

The theoretical value is significantly different from the experimental value, because we do not consider the influence of the deuteron binding energy on the negative π meson. The actual mass of π meson is equal to the sum of the deuteron binding energy and the mass of the π meson, namely:

$$
\begin{aligned}
m'_{\pi^-} &= 2.22452 + 139.57061 \\
&= 141.79513 Mev
\end{aligned} \tag{12}
$$

The original formula is equal to the following formula:

$$
\begin{aligned}
&= \frac{1}{2} \times \left(-2 \times \frac{938.2720813}{141.79513} + 5.58694702 \right) \times \frac{e}{2m_p c} \\
&= -1.9118116 \mu_N
\end{aligned} \tag{13}
$$

The ratio of the error between the theoretical value and the experimental value is calculated as follows:

$$
\begin{aligned}
\eta_n &= \frac{\mu_n^{W-theo}}{\mu_n^{\exp}} \times 100\% \\
&= \frac{1.9118116}{1.91304273} \times 100\% \\
&= 99.935646\%
\end{aligned} \tag{14}
$$

Namely, the accuracy of the theoretical value is less than 1‰, which is approximate to the experimental value. Accordingly, it is proven that the neutron decay process can generate negative π meson, namely: $n \to \pi^- + p$ is true.

Step II, we need to prove $\pi^- + p \to n$.

We need to discuss the influence of the actual and virtual processes on the magnetic moment. In previous paragraph, we have researched the π meson emission process during neutron decay, and such measurable reaction process is called as an actual process; oppositely, the existing unobservable reaction process is called as a virtual process. In the following paragraph, we will given an example for the typical virtual process, namely magnetic moment anomaly of proton.

The process for the u quark to absorb and emit the positive π meson in the proton is reciprocal to the process for the d quark to emit and absorb the negative π meson in the neutron, so the probability for absorption and emission is 1/2. Since such process is not supported by observation basis, it is a virtual process, specifically represented as follows:

$$p \Leftrightarrow \pi^+ + n \qquad (15)$$

Namely, the probability for the proton to be under left and right states in above equation is 1/2. When the proton is under the left state, the mass thereof is m_p; when the proton is under the right state, the mass thereof is equal to the sum of the mass of the positive π meson and the neutron. The mass corresponding to the magnetic moment of the proton is equal to the superposition of the masses under the two states, so the following formula can be obtained:

$$\begin{aligned} m_p^{W-theo} &= \frac{(m_{\pi^-}+m_n)}{2}+\frac{m_p}{2} \\ &= \frac{1}{2}\times(139.57061+939.57565+938.27081) \\ &= \frac{1}{2}\times 2017.4166 \\ &= 1008.7083 Mev \end{aligned} \quad (16)$$

The corresponding magnetic moment of the proton is as follows:

$$\begin{aligned} \overline{\mu}_p^{W-theo} &= 3\frac{m_p}{m_p^{W-theo}}\overline{\mu}_N \\ &= 3\times\frac{938.27081}{1008.7083}\overline{\mu}_N \\ &= 3\times\frac{938.27081}{1008.7083}\overline{\mu}_N \\ &= 2.7905118\overline{\mu}_N \end{aligned} \quad (17)$$

The ratio of the error between theoretical value and the experimental value is calculated as follows:

$$\begin{aligned} \eta_n &= \frac{\mu_p^{W-theo}}{\mu_p^{\exp}}\times 100\% \\ &= \frac{2.7905118}{2.79284735\,08}\times 100\% \\ &= 99.916374\% \end{aligned} \quad (18)$$

Due to such significant error, it is necessary to further consider the correction of the internal potential of the neutron upon the mass of the proton when the proton is under the right state.

$$m_p' = \frac{m_p}{m_n}\frac{(m_{\pi^-}+m_n)}{2} \quad (19)$$

After correction, the corresponding magnetic moment of the proton is as follows:

$$m_p^{W-theo} = \frac{m_p}{m_n}\frac{\left(m_{\pi^-} + m_n\right)}{2} + \frac{m_p}{2}$$
$$= \frac{1}{2}\times 0.99862347844\times\left(139.57061 + 939.575651\right) + \frac{1}{2}\times 938.2708$$
$$= 1007.9664 Mev \qquad (20)$$

The corresponding magnetic moment of the proton is as follows:

$$\overline{\mu}_p^{W-theo} = 3\frac{m_p}{m_p^{W-theo}}\overline{\mu}_N$$
$$= 3\times\frac{938.27081}{1007.9664}\overline{\mu}_N$$
$$= 3\times\frac{938.27081}{1007.9664}\overline{\mu}_N$$
$$= 2.7925657\overline{\mu}_N \qquad (21)$$

The ratio of the error between theoretical value and the experimental value is calculated as follows:

$$\eta_n = \frac{\mu_p^{W-theo}}{\mu_p^{\exp}}\times 100\%$$
$$= \frac{2.7925657}{2.7928473508}\times 100\%$$
$$= 99.989915\% \qquad (22)$$

Namely, the accuracy of the theoretical value is 0.1 ‰, approximate to the experimental value.

Through researching the magnetic moment anomaly of the neutron and the proton, we discover the following two rules:

(1) The reciprocal decay reaction formual $n \Leftrightarrow \pi^- + p$ is proven to be true; (2) The opinion of the intrinsic property determination by internal factor is also applicable to the research on the magnetic moment anomaly

of the neutron and the proton. Therein, the strong nuclear force is the internal force of the neutron and the proton, and the communication media thereof is the π meson. Therefore, the π meson is one of the most important factors which can influence the magnetic moment of the neutron and the proton.

In the following paragraph, we will continuously research the decay state of the electron. The electron and the proton can have collision reaction to generate the proton and electron neutrinos.

$$e + p \rightarrow n + \upsilon_e \quad (23)$$

$n \Leftrightarrow \pi^- + p$ has been proven to be true in the research on the magnetic moment of the neutron, so it can be put into the right side of the above formula to obtain:

$$e + p \rightarrow \pi^- + p + \upsilon_e \quad (24)$$

There is no need to neutralize the momentum difference by proton in above formula to meet the momentum conservation, so it can be simplified as follows:

$$e \rightarrow \upsilon_e + \pi^- \quad (25)$$

The above formula can meet Formula (5), but the electron is the smallest rest mass particle and cannot have the decay reaction, so in the decay mode, the electron emits an electron neutrino with negative mass to form the meson structure.

By analyzing 253 kinds of the decay modes of the electron particles (including 2 kinds of electrons, 7 kinds of μ particles and 244 kinds of τ particles) and the collision reaction of one kind of electron and proton, we have proven the objective existence of the decay state of the electron particles (Formula (5) can be met), thus avoiding the BUG of the potential energy tendency to infinity under the point state.

II. Solving of Magnetic Moment Anomaly of Electron by Weak Force Potential Method

2.1 Who is X meson?

As mentioned above, an electron particle can form X meson after losing a neutrino, but who is X meson? This question involves in the function of the neutrino in the weak decay process.

We explore the general property of the two groups of decay modes [1] $\begin{cases} X^0 \to l^- + l^+ & ① \\ X^\pm \to \overline{\upsilon}_l + l^\pm & ② \end{cases}$, where X represents the meson, l represents the electron particle, and $\overline{\upsilon}_l$ represents the anti-neutrino.

The decay mode ① includes two kinds of decay forms, namely the electromagnetic decay acting between the electric charges, and the weak nuclear force decay acting between the magnetic moments; the decay mode ② represents the pure weak force decay acting between the magnetic moments of the decay products. But the neutrino does not carry any electric charge, namely: there is no magnetic moment, and the weak force is caught in the existence antinomy. Therefore, it is impossible for the neutrino to become the stress particle of the weak force. Exactly as the photon which is the media for transmitting the electromagnetic force, the neutrino is similarly the media for transmitting the weak force.

If the decay modes ① and ② really have the general property, then the neutrino is regarded to transmit the magnetic moment interaction between an electron particle and anti-electron particle, but such anti-electron particle does not exist, so such weak interaction is equivalent to the interaction between an entity and an image, and the neutrino is equivalent to a mirror, and the electron particle can see itself with opposite electric charge in the mirror. We call such transmission mode of the neutrino as anti-mirroring action.

The electron particle always spontaneously emits a corresponding neutrino to decay into a meson state with internal structure from the point state. At the moment, we need to consider the composition of the meson state. Specifically, when an electron loses an electron neutrino, it will form a positronium due to the anti-mirroring action [27] [28]; when μ particle loses a μ neutrino, it will similarly form a μ + element; when τ particle loses a τ neutrino, it will similarly form a τ + element. The above three positive electron particle elements are uniformly called as positive lepton elements.

2.2 Solving of magnetic moment anomaly of electron family by weak force potential method

2.2.1 Electromagnetic action item

Schrodinger equation is adopted to solve the ground state function of the hydrogen atom.

$$\varphi(r) = e^{-r/a}, a = \alpha \frac{\hbar}{m_e c} \qquad (26)$$

The state function of the positive lepton element can meet the same ground state function, but the radius length is adjusted more or less.

$$\varphi(r) = e^{-r/a}, a = \pi \frac{\hbar}{m_i c} \qquad (27)$$

The static force potential operator between the electron and the positive electron image is written as follows:

$$\hat{V}_i(r) = -\frac{ke^2}{2r} \qquad (28)$$

The static force potential value is solved as follows:

$$\overline{V}(r)_i = \frac{\int \varphi(r) \hat{E}_i \varphi(r)^* dr^3}{\int \varphi(r) \varphi(r)^* dr^3} = -\left(\frac{\alpha}{2\pi}\right) m_i c^2 \qquad (29)$$

and $i = e, \mu, \tau$

2.2.2 Kinetic energy item

Among the positive lepton elements, the substantial motion process does not exist between the electron particle and the image thereof, so there is no need for us to consider the influence of the kinetic energy of the electron particles. Due to $e_i \to \upsilon_{e_i} + X$ decay reaction, when an electron particle loses a neutrino, it will change the energy of the electron particle, and the change of such energy shall be considered in the calculation process.

The decay process follows the energy conservation. The generation of the neutrino is the direct cause for the formation of the static force potential, so energy of the neutrino and the static force potential shall meet the energy conservation, namely:

$$\left(\hat{E}_{\upsilon_i}+\hat{V}_i(r)\right)\varphi(r)=0 \qquad (30)$$

This is similar with the energy conservation in the electron transition and radiation process, but radiation particle is the neutrino rather than the photon. Furthermore, the kinetic energy of the neutrino is calculated as follows:

$$\begin{cases}\overline{E}_{\upsilon_i}=\left(\dfrac{\alpha}{2\pi}\right)m_i c^2\\ \overline{P}_{\upsilon_i}=\left(\dfrac{\alpha}{2\pi}\right)m_i c\end{cases} \qquad (31)$$

Due to the momentum conservation before and after decay, we can obtain the momentum relationship of X meson:

$$\overline{P}_X+\overline{P}_{\upsilon_i}=0 \qquad (32)$$

The mass-energy equation is adopted to solve the kinetic energy. Firstly, the electron is the smallest rest mass particle, and it only can emit a neutrino with negative mass, so X meson is heavier than the electron; the result is diametrically opposite to the μ particle and the τ particle, so we write the X meson mass-energy equation corresponding to the electron as follows:

$$\begin{aligned} E_{Xe} &= \sqrt{m_e^{'2}c^4 + \overline{P}_X^2} \\ &= \sqrt{m_e^{'2}c^4 + \overline{P}_{\upsilon_i}^2} \\ &= \sqrt{m_e^{'2}c^4 + \left(\frac{\alpha}{2\pi}\right)^2 m_e^{'2}c^4} \\ &= m_e^{'}c^2\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2} \end{aligned} \tag{33}$$

The kinetic energy increase of a single electron is as follows:

$$\begin{aligned} \Delta E_{e1} &= E_X - E_e \\ &= \sqrt{m_e^{'2}c^4 + \overline{P}_{\upsilon_i}^2} - m_e^{'}c^2 \\ &= m_e^{'}c^2\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) \end{aligned} \tag{34}$$

The X meson mass-energy equation corresponding to the μ particle and the τ particle is as follows. The corresponding X meson is lighter than the above two particles, so we can obtain the following formula:

$$\begin{aligned} E_{X\mu(\tau)} &= \sqrt{m_{\mu(\tau)}^{'2}c^4 - \overline{P}_X^2} \\ &= \sqrt{m_{\mu(\tau)}^{'2}c^4 - \overline{P}_{\upsilon_i}^2} \\ &= \sqrt{m_{\mu(\tau)}^{'2}c^4 - \left(\frac{\alpha}{2\pi}\right)^2 m_{\mu(\tau)}^{'2}c^4} \\ &= m_{\mu(\tau)}^{'}c^2\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} \end{aligned} \tag{35}$$

The kinetic energy increase of a single μ particle or τ particle is as follows:

$$\begin{aligned} \Delta E_{\mu(\tau)1} &= E_{X\mu(\tau)} - E_{\mu(\tau)} \\ &= \sqrt{m_{\mu(\tau)}^{'2}c^4 - \overline{P}_{\upsilon_i}^2} - m_{\mu(\tau)}^{'}c^2 \\ &= m_{\mu(\tau)}^{'}c^2\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) \end{aligned} \tag{36}$$

The positive lepton element has single state (s=0) and triplet state (s=1), namely two states, and each state further includes positive and negative particles, so the kinetic energy increase of the whole decay state is equal to the kinetic energy increase of a single electron *2 (the number of the particles included under the state) *2 (number of states).

Namely, the kinetic energy increase of the electron decay state is as follows:

$$\begin{aligned}\Delta E_e &= 4\Delta E_{e1} \\ &= 4m_e^{'}c^2\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2}-1\right)\end{aligned} \qquad (37)$$

The kinetic energy increase of μ particle or τ particle decay state is as follows:

$$\begin{aligned}\Delta E_{\mu(\tau)} &= 4\Delta E_{\mu(\tau)} \\ &= 4m_{\mu(\tau)}^{'}c^2\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)\end{aligned} \qquad (38)$$

2.2.3 Interference action in the decay reaction

The general form of the weak nuclear potential and the eigen function mentioned in the paper ---- *The Research on Relationship between Neureinos and Weak Force* [30] are taken as the reference.

$$\begin{aligned}&\hat{V}_W(r) = -\frac{8\pi}{3}\hat{e}_1\cdot\hat{e}_2\delta(r) \\ &\begin{cases}\hat{e}_1 = g_1\dfrac{e}{2m_1c}\dfrac{\hbar}{2}(\alpha_x + i\alpha_y) \\ \hat{e}_2 = g_2\dfrac{e}{2m_2c}\dfrac{\hbar}{2}(\alpha_x - i\alpha_y)\end{cases} \\ &\varphi(r) = \exp(-r/a)\end{aligned} \qquad (39)$$

The weak nuclear potential moment between z-axis positive-negative spin states is as follows:

$$\Delta V_w = -\frac{1}{3} g_1 g_2 \frac{e^2\hbar^2}{m_1 m_2 c^2} a^{-3} \qquad (40)$$

$$a = \frac{\hbar}{m_X c}$$

When the decay products of the positive μ element and the positronium both include electrons, it is indicated that the two decay reactions have interference action, and Formula (40) can be converted as follows:

$$\Delta V_{we} = -\frac{1}{3} g_e^2 \frac{e^2\hbar^2}{m_e^2 c^2} \left(\frac{\hbar}{m_{Xe} c}\right)^{-3} \qquad (41\text{-}1)$$

$$\Delta V_{w\mu} = -\frac{1}{3} g_e^2 \frac{e^2\hbar^2}{m_e^2 c^2} \left(\frac{\hbar}{m_{X\mu} c}\right)^{-3} \qquad (41\text{-}2)$$

The interference ratio is solved according to $\frac{(41-1)}{(41-2)}$:

$$\eta_w = \frac{\Delta V_{we}}{\Delta V_{w\mu}} = \left(\frac{m_{Xe}}{m_{X\mu}}\right)^3 = \left(\frac{E_{Xe}}{E_{X\mu}}\right)^3 = \left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2} \left(\frac{m_e}{m_\mu}\right)^3 \qquad (42)$$

In Formula (42), the influence of the hedge effect on the electron mass is not considered. Therefore, I believe that X_e meson used in the section shall be calculated under the free state, without the need to consider the influence of the proton and electron system.

The influence of the interference ration on the magnetic moment of electron and μ particle is as follows:

$$\overline{E}_{e3} = 2\eta_w m_e^{'} \qquad (43)$$

$$\overline{E}_{\mu 3} = 4\eta_w m_\mu \qquad (44)$$

The following two factors are considered: ① the positive lepton element has single state (s=0) and triplet state (s=1), namely two states. ② the decay product of the positronium is actually a kind of electron, and the positronium has two kinds of decay products (electron and anti-electron neutrino). Therefore, the influence of the interference ratio on the magnetic moment of the electron shall be multiplied with coefficient 2 (2 kinds of states * 1 kind of product), but the influence of the magnetic moment of the μ particle shall be multiplied with coefficient 4 (2 kinds of states * 2 kinds of products).

The decay mode of τ particle includes the strong nuclear force decay, and the decay rule thereof is complicated, so the interference thereof between the decay reactions with other electron particles.

2.2.4 Influence of interaction of magnetic moment

Coherence exists between the electron and the μ particle, such coherence is related to the following factors: ① the probability of the decay reaction; ② the free combination of the decay products of different decay reactions.

① the following formulae can be met:

$$\frac{\mathrm{Re}}{R\mu}=\frac{m_e^2\left(m_x^2-m_e^2\right)^2}{m_\mu^2\left(m_x^2-m_\mu^2\right)^2} \qquad (45)$$

and

$$\mathrm{Re}+R\mu=1 \qquad (46)$$

Where m_x represents the mass of the unknown meson, and Formulae

(45) and (46) include three unknown factors, and cannot be solved. We can input the experimental value of the magnetic moment of the μ particle to inversely deduce R_μ; similarly, we can inversely deduce R_e through the magnetic moment of the electron or through solving the mass difference between the two kinds of K mesons.

$$\begin{cases} \mathrm{Re} = \dfrac{3}{8} \\ R\mu = \dfrac{5}{8} \end{cases} \tag{47}$$

② The decay reactions of x meson include electron $(e,\overline{\upsilon}_e)$ decay reaction and μ particle $(\mu,\overline{\upsilon}_\mu)$ decay reaction. The free combination of the decay products of the decay reactions includes $(e,\overline{\upsilon}_e)\cup(\mu,\overline{\upsilon}_\mu)$, $(e,\overline{\upsilon}_\mu)\cup(\mu,\overline{\upsilon}_e)$ and $(e,\mu)\cup(\overline{\upsilon}_\mu,\overline{\upsilon}_e)$, wherein the first combination belongs to the normal decay reaction combination, and the second combination and the third combination belong to the free combinations of the decay products of different decay reactions and occupy 2/3 of all the combinations.

The moments of the two lepton elements between single state (s=0) and triplet state (s=1) are orderly written as follows:

$$\overline{E}_{e4} = \frac{2}{3}\cdot\frac{2}{3} g_e^2 \alpha^4 \,\mathrm{Re}\, m_e' c^2 \tag{48}$$

$$\overline{E}_{\mu 4} = \frac{2}{3}\cdot\frac{2}{3} g_\mu^2 \alpha^4 (1-\mathrm{Re}) m_\mu c^2 \tag{49}$$

The problem of the vicious circle of g factor may occur in the calculation based on Formulae (48) and (49). In order to avoid above problem, we need to consider the ideal value of the moment solved under the ideal condition, namely magnetic moment anomaly of the lepton, and $g_e = g_\mu = 2$ is true at the moment.

4.5 Hedge effect

The hedge effect between the electron and the proton may influence the magnetic moment mass of the electron:

$$m_e^{'} = \left(1 - \frac{m_e}{m_p}\right) m_e \tag{50}$$

It is indicated that the interaction between the electron and the proton influences the intrinsic property of the electron, thus proving in the time series that $n \rightarrow p + e + \overline{\upsilon}_e$ decay reaction is the source of the electron generation.

Formulae (26) - (50) are combined to establish the magnetic moment mass of the electron particles under the decay state as follows:

$$m_{e0} = \left[1 - \left(1 - \frac{m_e}{m_p}\right)\left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + 2\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3 + \frac{16}{9}\mathrm{Re}\,\alpha^4\right)\right] m_e \tag{51}$$

$$m_{\mu 0} = \left[1 - \left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + 4\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3 + \frac{16}{9}(1-\mathrm{Re})\alpha^4\right)\right] m_\mu \tag{51}$$

$$m_{\tau 0} = \left[1 - \left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + \ldots\right)\right] m_\tau \tag{52}$$

The magnetic moment constant g is defined as follows:

$$g_i = -2 \times \frac{m_i}{m_{i0}}, i = e, \mu, \tau \tag{53}$$

Please notice that the physical significance of the magnetic moment constant is as the same as that of the Lande g factor, and only the names are different.

The formula for solving the magnetic moment g constant of the electron is as follows:

$$g_{etheo}=-2\left[1-\left(1-\frac{m_e}{m_p}\right)\left(\left(\frac{\alpha}{2\pi}\right)-4\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2}-1\right)+2\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3+\frac{16}{9}\mathrm{Re}\,\alpha^4\right)\right]^{-} \tag{54}$$

$$g_{\mu theo}=-2\left[1-\left(\left(\frac{\alpha}{2\pi}\right)-4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)+4\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3+\frac{8}{3}\frac{2}{3}(1-\mathrm{Re})\alpha^4\right)\right]^{-} \tag{55}$$

$$g_{\tau theo}=-2\left[1-\left(\left(\frac{\alpha}{2\pi}\right)-4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)+\ldots\right)\right]^{-} \tag{56}$$

The following table is listed for evaluation, and the calculated values are compared with the experimental value.

Tab.5 Magnetic Moment Evaluation Table for Electron Family

No.	Item Name	Magnetic Moment of Electron		Magnetic Moment of μ Particle		Magnetic Moment of τ Particle	
		Formula for Magnetic Moment of Electron	Numerical Value	Formula for Magnetic Moment of μ Particle	Numerical Value	Formula for Magnetic Moment of τ Particle	Numerical Value
①	Electromagnetic action item	$\left(\frac{\alpha}{2\pi}\right)$	0.00116140973243	$\left(\frac{\alpha}{2\pi}\right)$	0.00116140973243	$\left(\frac{\alpha}{2\pi}\right)$	0.00116140973243
②	Momentum energy item	$-4\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$	-0.00000269774422	$-4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$	0.00000269774604	$-4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$	0.00000269774604
③	Interference action between decay reactions	$2\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3$	0.00000022624552	$4\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3$	0.00000045249104	To be solved	0
④	Influence of magnetic moment interaction	$\frac{16}{9}\mathrm{Re}\,\alpha^4$	0.00000000189047	$\frac{16}{9}(1-\mathrm{Re})\alpha^4$	0.00000000315079	To be solved	0
⑤	Hedge effect	$\left(1-\frac{m_e}{m_p}\right)$	0.99945538297865	There is no this item		There is no this item	

⑥	(①+②+③+④)*(1-⑤)	$\frac{\Delta m_{e0}}{m_e}$	0.00115830894568	$\frac{\Delta m_{\mu 0}}{m_\mu}$	0.00116456312030	$\frac{\Delta m_{\tau 0}}{m_\tau}$	0.00116410747847
⑦	1-⑥	$\frac{m_{e0}}{m_e}$	0.99884169105432	$\frac{m_{\mu 0}}{m_\mu}$	0.99883543687970	$\frac{m_{\tau 0}}{m_\tau}$	0.99883589252153
⑧	1/⑦	$\frac{m_e}{m_{e0}}$	1.00115965218117	$\frac{m_\mu}{m_{\mu 0}}$	1.00116592090879	$\frac{m_\tau}{m_{\tau 0}}$	1.00116546420407
⑨	⑧-1	a_{etheo}	0.00115965218117	$a_{\mu theo}$	0.00116592090879	$a_{\tau theo}$	0.00116546420407
⑩	mag. mom. anomaly	$a_{e\exp}$	0.00115965218091（26）	$a_{\mu\exp}$	0.00116592089(63)	$a_{\tau\exp}$	> -0.052 and < 0.013 (CL = 95%) OUR LIMIT
⑪	⑨-⑩	$a_{etheo} - a_{e\exp}$	2.6(26)E-13	$a_{\mu theo} - a_{\mu\exp}$	0.2(63)E-10	$a_{\tau theo} - a_{\tau\exp}$	Basically consistent with the experimental value
⑫	-⑧*2	g_{etheo}	-2.00231930436235	$g_{\mu theo}$	-2.00233184181758	$g_{\tau theo}$	-2.00233092840813
⑬	g[29] factor	$g_{e\exp}$	-2.00231930436182(52)	$g_{\mu\exp}$	-2.0023318418(13)	$g_{\tau\exp}$	No numerical value
⑭	⑫-⑬	$g_{etheo} - g_{e\exp}$	5.3(52)E-13	$g_{\mu theo} - g_{\mu\exp}$	0(13)E-10	$g_{\tau theo} - g_{\tau\exp}$	No comparison

Obviously, the g theoretical values of the electron and the μ particle are basically consistent with the corresponding experimental value, with more than ten figures as the same; the magnetic moment anomaly of the τ particle is within the range of the experimental value and can meet the prediction requirements (the experimental values in the table are all calculated according to the intermediate values, and the error analysis is not carried out for all the theoretical values obtained thereby).

III. Analysis of Advantages and Disadvantages of Two Methods for Solving Magnetic Moment Anomaly of Electron Family

In allusion to the analysis of the advantages and disadvantages of the two methods for solving the magnetic moment anomaly of the electron family, the two methods are compared with each other in the aspects of action type, theoretical accuracy of magnetic moment anomaly, particle state, basic reaction type, potential energy form, formula for magnetic moment anomaly of electron family and seven major items of detail. Therein, the comparison of the details is the comparison of the two solving methods, further including magnetic action comparison, weak nuclear force action comparison, interference items between the electron particles and baryon influence item comparison (please refer to Tab.6 for the details).

According to the comparison in Tab.6, we can discover that the weak force potential method is comprehensively superior to QED method, thus becoming the best method for explain the three kinds of electron particles.

Tab.6 Analysis Table of Advantages and Disadvantages of Two Methods for Solving Magnetic Moment Anomaly of Electron Family

No.	Item Name	QED Method	Weak Force Potential Method	Evaluation of Advantages and Disadvantages
1	Action type	Electromagnetic action between the electric charges belongs to the external force	Weak interaction between the particle decays or the magnetic moments belongs to the internal force.	The internal factor determines the intrinsic property of the particle, so it is reasonable to select the weak nuclear force.
2	Theoretical accuracy of magnetic moment anomaly	Electron: basically the same as the experimental value; μ particle: significant error; τ particle: meeting the experimental value range	Electron and μ particle: basically the same as the experimental value; τ particle: meeting the experimental value range	The weak force potential method is better (please refer to Tab.1 for details)
3	Particle state	Point state	Decay from the point state to the meson state	It is usually believed that the electron particles are point state particles, but according to the analysis of 189 kinds of electron particles, it is discovered that the electron particles can spontaneously decay into the meson state from the point state, thus avoiding the BUG of potential energy tendency to infinity under the point state.

4	Basic reaction type	The simplest photon-electron conversion model: $\begin{cases} e \to e+\gamma \\ \gamma \to e+e \\ e+e \to 2\gamma \\ e+\gamma \to e \end{cases}$	Decay mode: $i \to \upsilon_i + X, i = e, \mu, \tau$	Actually, the simplest photon-electron conversion model has included the weak interaction, but QED method cannot solve the weak force potential value, so the conclusion thereof needs to be further determined.
5	Potential energy form	Electrostatic potential $\hat{V}_e(r) = -\frac{ke^2}{r}$	Weak force potential $\hat{V}_W(r) = -\frac{8\pi}{3}\hat{e}_1 \cdot \hat{e}_2 \delta(r)$	The former charge is the electric charge; the latter charge is the magnetic moment; the magnetic moment is closely related to the electric charge, and the latter is the independent variable of the former.
6	Comparison of the formula for magnetic moment anomaly of electron family	$a_e = (g-2)/2$ $a_e = a_e(QED) + a_e(hadronic) + a_e(eletroweak)$ $a_e(QED) = \frac{\alpha}{2\pi}a_e^{(2)} + \left(\frac{\alpha}{2\pi}\right)^2 a_e^{(4)} + \left(\frac{\alpha}{2\pi}\right)^3 a_e^{(6)} + \left(\frac{\alpha}{2\pi}\right)^4 a_e^{(8)} \ldots$ $a_e^{2n} = A_1^{2n} + A_2^{2n}(m_e/m_\mu) + A_2^{2n}(m_e/m_\tau) + A_3^{2n}(m_e/m_\mu, m_e/m_\tau)$	$a_e = \left[1-\left(1-\frac{m_e}{m_p}\right)\left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + 2\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3 + \frac{16}{9}\mathrm{Re}\,\alpha^4\right)\right]^{-} - 1$	1. From the aspect of the complexity of the formula, the weak force potential method is relatively simple; 2. From the aspect of the solution, QED is equivalent to the 2n-power coefficient of the fine structure constant of the independent solution; but it is believed in the weak force potential method that the key factor influencing the magnetic moment of the electron is the change of the mass, and the influence of the potential energy, the kinetic energy and the proton-electron system on the hedge effect is comprehensively considered.
		$a_\mu^{SM} = a_\mu^{QED} + a_\mu^{EW} + a_\mu^{Hadron}$	$a_\mu = \left[1-\left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + 4\left(\frac{1+\left(\frac{\alpha}{2\pi}\right)^2}{1-\left(\frac{\alpha}{2\pi}\right)^2}\right)^{3/2}\left(\frac{m_e}{m_\mu}\right)^3 + \frac{8}{3}\frac{2}{3}(1-\mathrm{Re})\alpha^4\right)\right]^{-} - 1$	
		$a_\tau^{SM} = a_\tau^{QED} + a_\tau^{EW} + a_\tau^{HAD}$	$a_\tau = 2\left[1-\left(\left(\frac{\alpha}{2\pi}\right) - 4\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2} - 1\right) + \ldots\right)\right]^{-} - 1$	

<table>
<tr><td>7</td><td colspan="4">Comparison of Details</td></tr>
<tr><td rowspan="4">7.1</td><td rowspan="4">Comparison of electromagnetic action</td><td>$a_e(QED)=\frac{\alpha}{2\pi}a_e^{(2)}+\left(\frac{\alpha}{2\pi}\right)^2 a_e^{(4)}+\left(\frac{\alpha}{2\pi}\right)^3 a_e^{(6)}+\left(\frac{\alpha}{2\pi}\right)^4 a_e^{(8)}\ldots$
$a_e^{2n}=A_1^{2n}+A_2^{2n}(m_e/m_\mu)+A_2^{2n}(m_e/m_\tau)+A_3^{2n}(m_e/m_\mu,m_e/m_\tau)$</td><td>$\overline{E}_{e1}=-\left(\frac{\alpha}{2\pi}\right)m_e^{'}c^2$
$\overline{E}_{e2}=4m_e^{'}c^2\left(\sqrt{1+\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$</td><td rowspan="4">1. From the aspect of the difficulty of the solution formula, the weak force potential method is relatively simple; 2. From the process of the solution formula, the weak force potential method is partial to the traditional method, e.g., dirac equation, but QED method does not have any example.</td></tr>
<tr><td>$a_\mu^{QED}=\frac{\alpha}{2\pi}+0.765857410(27)\left(\frac{\alpha}{2\pi}\right)^2+24.05050964(87)\left(\frac{\alpha}{2\pi}\right)^3 a$
$+130.8055(80)\left(\frac{\alpha}{2\pi}\right)^4+663(20)\left(\frac{\alpha}{2\pi}\right)^5\ldots$</td><td>$\overline{E}_{\tau1}=-\left(\frac{\alpha}{2\pi}\right)m_\tau^{'}c^2$
$\overline{E}_{\tau2}=4m_\tau^{'}c^2\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$</td></tr>
<tr><td>$a_\tau(QED)=A_1+A_2(m_\tau/m_e)+A_2(m_\tau/m_\mu)+A_3(m_\tau/m_e,m_\tau/m_\mu)$</td><td>$\overline{E}_{\tau1}=-\left(\frac{\alpha}{2\pi}\right)m_\tau^{'}c^2$
$\overline{E}_{\tau2}=4m_\tau^{'}c^2\left(\sqrt{1-\left(\frac{\alpha}{2\pi}\right)^2}-1\right)$</td></tr>
<tr><td>The electromagnetic action process is very complicated, so it is necessary to solve all a_e^{2n} s; according to the newest data referenced in the paper, the calculation has been currently promoted to the first number of the fifth item, namely A_1^{10}.</td><td>We only need to consider two factors: the first one is the static potential force; the second one is the kinetic energy brought by the anti-electron neutrino, wherein the kinetic energy brought by the anti-electron neutrino is independently owned by the weak force potential method!</td></tr>
<tr><td rowspan="3">7.2</td><td rowspan="3">Comparison of weak nuclear force</td><td>$a_e(electroweak)=0.0297(5)\times10^{-12}$</td><td>$\overline{E}_{e3}=2\eta_w m_e^{'}$</td><td rowspan="3">If the weak force is not identified, how to unify the electric weak force?</td></tr>
<tr><td>$a_\mu^{EW}=a_\mu^{EW}[1-loop]+a_\mu^{EW}[2-loop]$</td><td>$\overline{E}_{\mu3}=4\eta_w m_\mu$</td></tr>
<tr><td>$a_\tau^{EW}=a_\tau^{EW}[1\ loop]+a_\tau^{EW}[2\ loop]$</td><td>0</td></tr>
</table>

		Compared with the electromagnetic action, this item has slight influence.	It is weak force potential energy.	
7.3	Interference item between the electron particles	There is no this item	$\begin{cases} \overline{E}_{e4} = \frac{16}{9}\alpha^4 \mathrm{Re}\, m_e^{'} c^2 \\ \overline{E}_{\mu 4} = \frac{2}{3}\cdot\frac{2}{3} g_\mu^2 \alpha^4 (1-\mathrm{Re}) m_\mu c^2 \end{cases}$	The weak force potential method has the evidence chain, and such relevancy evidence is more convictive.
			1 1. This item is the interference item between the electron and μ particle, and is the key evidence for independently verifying the weak force potential method.	
7.4	Comparison of baryon influencing items	$a_\mu(hadronic) = (1.866(10)(5) - 0.2234(12)(7) + 0.035(10)) \times 10^{-12}$	$m_e^{'} = \left(1 - \frac{m_e}{m_p}\right) m_e$	Relevant example has been provided for the hedge effect during hydrogen nucleus solution, but it is a unique example which can influence the intrinsic property of the electron. It can predict new phenomenon and contribute to the theoretical accuracy.
		$a_\mu^{Had}[NLO]$	There is no this item	
		$a_\tau^{HAD} = a_\tau^{HLO} + a_\tau^{HHO}(vp) + a_\tau^{HHO}(lbl)$	There is no this item	
		Compared with the electromagnetic action, this item has slight influence.	The hedge effect between the proton and the electron can influence the effective mass of the electron, and when such external effect influences the intrinsic property of the electron, there is only one reasonable explanation, namely: the root reaction of the electron is $n \to p + e + \overline{\upsilon}_e$, and this can explain why our universe is not annihilated by the positive and negative electron pair.	

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