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Colorization of Gell-mann-Nishijima Relation and Mass Principle, Origins of Mass; Fermions and Charges, Bosons and Color-Pairs

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Abstract- This paper offers color representation of Gell-mann-Nishijima Relation for quarks and leptons, in which the three quantum C *numbers*, Q electrical charge, I_3 isospin and Y hypercharge all are colorized into three quantum *colored numbers* $\mathbf{Q}$, $\mathbf{I}_3$ and $\mathbf{Y}$. *Mass Principle* is posulated to account for the mass effect of electrical charge $\mathbf{Q}$. Particle mass *M* is suggested to be propertional to the scalar products $\mathbf{Q}^2$ of electrical charge $\mathbf{Q}$ of the particle. Further the observed twelve elementary fermion mass spectrum are given, which include those ones of three generation $\upsilon_e, \upsilon_\mu, \upsilon_\tau$ neutrinos. Although neutrinos are neutral particles, but their scalar products $\mathbf{Q}^2(\upsilon)$ could be nonzero values. This paper presents a boson particle color mechanism about electrical charge $\mathbf{Q}(B)$, with which Higgs boson h, and Z, γ, W^-, W^+ bosons could be constructed into the bound states of an elementary fermion F and a anti-elementary fermion $\overline{\mathrm{F}}$, each one with an opposite imaginary color $\boldsymbol{\xi}$ of a Color-Pair $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}, \xi)$, Further the masses $M(B)$ of these bosons could be obtained by Mass Principle.

Keywords: color of isospin, color of hypercharge, color of electric charge, color representation of gell-mann-nishijima relation, mass principle, ECCP, electric charge color-pair, higgs hypercharge, higgs field.

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0. Introduction

In paper [1], we assumed: Based on Pauli Exclusion Principle, all the six flavour quarks are attributed to be the conponents of a common isospin multiplet. At the same time, these conponents are assigned a three dimension colour spectral line array marked by a symbol for colored isospin $I_3(q_{\mathrm{RGB}})$, $q_{\mathrm{RGB}}=(q_{\mathrm{R}}, q_{\mathrm{G}}, q_{\mathrm{B}})$. $q=t, c, u, d, s, b$. In paper [2], in researching the relationship between the lepton number and matrix PMNS, analogy to quarks, for lepton, another colored isospin symbol $I_3(l_{\mathrm{RGB}})$, $l_{\mathrm{RGB}}=(l_{\mathrm{R}}, l_{\mathrm{G}}, l_{\mathrm{B}})$. $l=\upsilon_\tau, \upsilon_\mu, \upsilon_e, e^-, \mu^-, \tau^-$. is introduced too. we see: basing on $I_3(q_{\mathrm{RGB}})$ and $I_3(l_{\mathrm{RGB}})$ could give a unified isospin description for all the quarks and all the leptons.

[3] " There are some lingering issues that......does not explain the different values of the quantum numbers like the electric charge Q, weak isospin I or hyperchare Y that each particle has ". Encountering with such puzzled problems, an epiphany appears: Since Gell-mann-Nishijima Relation in the Standard Model SM, includes just right the above three quantum numbers Q, I_3 and Y mentioned above, and one of the three, isospin, *a unified isospin description* (Ref Table1 and Table2), that for all for all the quarks and all the leptons, has been constructed, further the regularies of " lingering issues " of other remaining two quantum numbers, Q and Y could also be obtained. The correct values of Q and Y are scheduled as Table5 and Table6.

Table1 and Table2 offer orthogonal normalization colored isospin $\mathbf{I}_3$ representation of colored quarks and colored leptons, and by Colorization of Gell-mann-Nishijima Relation, the other two colored quantum numbers, the corlored electrical charge **Q** and the colored hypercharge **Y** can be obtained.

The *scalar product* $\mathbf{Q}^2$ of electrical charge **Q** of the particle is the essential role in this paper, by wihch *mass principle* is realised. The first example of scalar product $\mathbf{Q}^2$ is $\mathbf{Q}^2(e^-)$, due to electron is the stablest charged fermion particle in nature, so $\mathbf{Q}^2(e^-)$ is used to be the scaling factor in mass principle.

In the frame of SM, the induced-mass of a elementary fermion by Yukawa coupling of the Higgs doublet Φ with the fermion requires the fermion of both chiralities. But neutrion υ, an unluchy fermion particle, that is a non-chiral object in exprimental nature, therefore a left-handed neutrino υ_L remain massless in current theory. On the other hand, neutrino is indeed to possess mass m, neutrino oscillations phenomenas among three different flavors can account for the existence of nuutrino mass with the precision squared $\left|\Delta m_{ij}^2\right| = m_i^2 - m_j^2$, whose calculations are packed into PMNS Matrix. But This matrix is only a parametrized math processor. On the contrary, by *mass principle,* because of its clear physical picture, it is easy to use corlored charge $\mathbf{Q}(q)$ and $\mathbf{Q}(l)$ to calculate the twelve elementary fermion mass spectrum, especially to use neutrino electrical charge $\mathbf{Q}(\upsilon)$ to calculate the massess of three generation $\upsilon_e, \upsilon_\mu, \upsilon_\tau$ neutrinos, although $Q(\upsilon)$ is electrical charge value zero.

The paper suggests: Boson's electrical charge $\mathbf{Q}(B)$ is a " composite " of a fermion's electrical charge $\mathbf{Q}(\mathrm{F},\xi)$ and a anti-fermion's electrical charge $\mathbf{Q}(\overline{\mathrm{F}},\xi)$. The fermion and the anti-fermion with an opposite color imaginary ξ of a Color-Pair $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}, \xi) = \mathbf{Q}(\mathrm{F},\xi) + \mathbf{Q}(\overline{\mathrm{F}},\xi)$.

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Part. A: Color Representation of Gell-mann-Nishijima Relation for Quarks and Leptons

In Standard Model SM, Gell-mann-Nishijima Relation (1) consists of three quantum numbers: Q electrical charge, T_3 isospin and Y hyercharge

$$Q = T_3 + \frac{1}{2} Y \tag{1}$$

- In strong interaction, T_3 stands for *strong* isospin $\subset SU(2)_q$. $T_3 = \frac{\pm 1}{2}$ for $\begin{pmatrix} u \\ d \end{pmatrix}, \begin{pmatrix} c \\ s \end{pmatrix}, \begin{pmatrix} t \\ b \end{pmatrix}$. Y is a constant that includes two quantum numbers B baryon number & S strangeness number

$$Y = B + S + C + B + T \tag{2}$$

- In electroweak interaction, T_3 stands for *weak* isospin $\subset SU(2)_L$. $T_3 = \frac{\pm 1}{2}$ for $\begin{pmatrix} \upsilon_e \\ e^- \end{pmatrix}, \begin{pmatrix} \upsilon_\mu \\ \mu^- \end{pmatrix}, \begin{pmatrix} \upsilon_\tau \\ \tau^- \end{pmatrix}$ Y the *weak* hypercharge $\subset U(1)_Y$ that related to the definition of weak hypercharge below

$$j^\mu_{\text{em}} - j^\mu_3 = \frac{1}{2} j^\mu_Y \tag{3}$$

The logistic route for the *character of color* for three quantum numbers T_3, Y and Q that appear in formuls (1) will be elaborated following

1. Color of Isospin

In paper [1] we use "color spectrum" $q_{\text{RGB}} = (q_{\text{R}}, q_{\text{G}}, q_{\text{B}})$ of flavor of quarks to put an quark isodoublet (u, d) and four quark isosinglets s, c, b, t all into a common multiplet, further these six flavors are treated equally in one isotopic space. q_{RGB} is *Color of Isospin* for quarks. Then analogy to quarks, in paper [2] the possible existence of lepton color $l_{\text{RGB}} = (l_{\text{R}}, l_{\text{G}}, l_{\text{B}})$, for τ^- μ^- e^- charged leptons and υ_τ υ_μ υ_e neutral leptons, is suggested. Later more advanced understanding of them are labelled by Table1 and Table2 below.

The observable quantum numbers $I_3(q)$ and $I_3(l)$ are given from q_{RGB} and l_{RGB}

$$\text{quark color } q_{\text{RGB}}=(q_{\text{R}}, q_{\text{G}}, q_{\text{B}}) \qquad \text{lepton color } l_{\text{RGB}}=(l_{\text{R}}, l_{\text{G}}, l_{\text{B}}) \tag{4}$$

$$I_3(q) = \tfrac{1}{3}(q_{\text{R}} + q_{\text{G}} + q_{\text{B}}) \qquad I_3(l) = \tfrac{1}{3}(l_{\text{R}} + l_{\text{G}} + l_{\text{B}}) \tag{5}$$

Notation: the symbol of isospin, labelled by T in SM and by I in STS

In this paper, we will use *Orthogonal Normalization Color Representation of Isospin* $\mathbf{I}_3(q)$ & $\mathbf{I}_3(l)$ for quarks and leptons following.

Table 1: Orthogonal Normalization Color Representation $q_{\text{RGB}}=(q_{\text{R}}, q_{\text{G}}, q_{\text{B}})$ of Quark Isospin $\mathbf{I}_3(q)$

$\mathbf{I}_3(t)$	$\mathbf{I}_3(c)$	$\mathbf{I}_3(u)$	$\mathbf{I}_3(d)$	$\mathbf{I}_3(s)$	$\mathbf{I}_3(b)$
$I_3(t)\ \frac{+5}{2}$	$I_3(c)\ \frac{+3}{2}$	$I_3(u)\ \frac{+1}{2}$	$I_3(d)\ \frac{-1}{2}$	$I_3(s)\ \frac{-3}{2}$	$I_3(b)\ \frac{-5}{2}$
$t_{\text{R}}\ \ t_{\text{G}}\ \ t_{\text{B}}$	$c_{\text{R}}\ \ c_{\text{G}}\ \ c_{\text{B}}$	$u_{\text{R}}\ \ u_{\text{G}}\ \ u_{\text{B}}$	$d_{\text{R}}\ \ d_{\text{G}}\ \ d_{\text{B}}$	$s_{\text{R}}\ \ s_{\text{G}}\ \ s_{\text{B}}$	$b_{\text{R}}\ \ b_{\text{G}}\ \ b_{\text{B}}$
$\frac{+15}{12}\ \ \frac{+42}{12}\ \ \frac{+33}{12}$	$\frac{+3}{12}\ \ \frac{+30}{12}\ \ \frac{+21}{12}$	$\frac{-9}{12}\ \ \frac{+18}{12}\ \ \frac{+9}{12}$	$\frac{-17}{12}\ \ \frac{0}{12}\ \ \frac{-1}{12}$	$\frac{-77}{12}\ \ \frac{-12}{12}\ \ \frac{+35}{12}$	$\frac{-185}{12}\ \ \frac{-24}{12}\ \ \frac{+119}{12}$
$(\frac{+15}{12}, \frac{+42}{12}, \frac{+33}{12})$	$(\frac{+3}{12}, \frac{+30}{12}, \frac{+21}{12})$	$(\frac{-9}{12}, \frac{+18}{12}, \frac{+9}{12})$	$(\frac{-17}{12}, \frac{0}{12}, \frac{-1}{12})$	$(\frac{-77}{12}, \frac{-12}{12}, \frac{+35}{12})$	$(\frac{-185}{12}, \frac{-24}{12}, \frac{+119}{12})$

Table 2: Orthogonal Normalization Color Representation $l_{\text{RGB}}=(l_{\text{R}}, l_{\text{G}}, l_{\text{B}})$ of Lepton Isospin $\mathbf{I}_3(l)$

$\mathbf{I}_3(\upsilon_\tau)$	$\mathbf{I}_3(\upsilon_\mu)$	$\mathbf{I}_3(\upsilon_e)$	$\mathbf{I}_3(e^-)$	$\mathbf{I}_3(\mu^-)$	$\mathbf{I}_3(\tau^-)$
$I_3(\upsilon_\tau)\ \frac{+5}{2}$	$I_3(\upsilon_\mu)\ \frac{+3}{2}$	$I_3(\upsilon_e)\ \frac{+1}{2}$	$I_3(e^-)\ \frac{-1}{2}$	$I_3(\mu^-)\ \frac{-3}{2}$	$I_3(\tau^-)\ \frac{-5}{2}$
$\upsilon_{\tau\text{R}}\ \ \upsilon_{\tau\text{G}}\ \ \upsilon_{\tau\text{B}}$	$\upsilon_{\mu\text{R}}\ \ \upsilon_{\mu\text{G}}\ \ \upsilon_{\mu\text{B}}$	$\upsilon_{e\text{R}}\ \ \upsilon_{e\text{G}}\ \ \upsilon_{e\text{B}}$	$e^-_{\text{R}}\ \ e^-_{\text{G}}\ \ e^-_{\text{B}}$	$\mu^-_{\text{R}}\ \ \mu^-_{\text{G}}\ \ \mu^-_{\text{B}}$	$\tau^-_{\text{R}}\ \ \tau^-_{\text{G}}\ \ \tau^-_{\text{B}}$
$\frac{-26}{6}\ \ \frac{-23}{6}\ \ \frac{+94}{6}$	$\frac{-8}{6}\ \ \frac{-5}{6}\ \ \frac{+40}{6}$	$\frac{-2}{6}\ \ \frac{+1}{6}\ \ \frac{+10}{6}$	$\frac{-6}{6}\ \ \frac{-6}{6}\ \ \frac{+3}{6}$	$\frac{-12}{6}\ \ \frac{-12}{6}\ \ \frac{-3}{6}$	$\frac{-18}{6}\ \ \frac{-18}{6}\ \ \frac{-9}{6}$
$(\frac{-26}{6}, \frac{-23}{6}, \frac{+94}{6})$	$(\frac{-8}{6}, \frac{-5}{6}, \frac{+40}{6})$	$(\frac{-2}{6}, \frac{+1}{6}, \frac{+10}{6})$	$(\frac{-6}{6}, \frac{-6}{6}, \frac{+3}{6})$	$(\frac{-12}{6}, \frac{-12}{6}, \frac{-3}{6})$	$(\frac{-18}{6}, \frac{-18}{6}, \frac{-9}{6})$

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Next two tables are the observable values of isospin for quarks and leptons from Table1 and Table2

Table 3: Values of Orthogonal Normalization Isospin for color quarks

Quark $I_3(q_\alpha)$	=	$\frac{1}{3}(q_R + q_G + q_B)$			$I_3(q_\alpha)$
t	=	$\frac{1}{3}(\frac{+15}{12} + \frac{+42}{12} + \frac{+33}{12})$	= $\frac{1}{3}(\frac{+90}{12})$	=	$+5/2$
c	=	$\frac{1}{3}(\frac{+3}{12} + \frac{+30}{12} + \frac{+21}{12})$	= $\frac{1}{3}(\frac{+54}{12})$	=	$+3/2$
u	=	$\frac{1}{3}(\frac{-9}{12} + \frac{+18}{12} + \frac{+9}{12})$	= $\frac{1}{3}(\frac{+18}{12})$	=	$+1/2$
d	=	$\frac{1}{3}(\frac{-17}{12} + \frac{0}{12} + \frac{-1}{12})$	= $\frac{1}{3}(\frac{-18}{12})$	=	$-1/2$
s	=	$\frac{1}{3}(\frac{-77}{12} + \frac{-12}{12} + \frac{+35}{12})$	= $\frac{1}{3}(\frac{-54}{12})$	=	$-3/2$
b	=	$\frac{1}{3}(\frac{-185}{12} + \frac{-24}{12} + \frac{+119}{12})$	= $\frac{1}{3}(\frac{-90}{12})$	=	$-5/2$

Table 4: Values of Orthogonal Normalization Isospin for color leptons

Lepton $I_3(l_\alpha)$	=	$\frac{1}{3}(l_R + l_G + l_B)$			$I_3(l_\alpha)$
υ_τ	=	$\frac{1}{3}(\frac{-26}{6} + \frac{-23}{6} + \frac{+94}{6})$	= $\frac{1}{3}(\frac{+45}{6})$	=	$+5/2$
υ_μ	=	$\frac{1}{3}(\frac{-8}{6} + \frac{-5}{6} + \frac{+40}{6})$	= $\frac{1}{3}(\frac{+27}{6})$	=	$+3/2$
υ_e	=	$\frac{1}{3}(\frac{-2}{6} + \frac{+1}{6} + \frac{+10}{6})$	= $\frac{1}{3}(\frac{+9}{6})$	=	$+1/2$
e^-	=	$\frac{1}{3}(\frac{-6}{6} + \frac{-6}{6} + \frac{+3}{6})$	= $\frac{1}{3}(\frac{-9}{6})$	=	$-1/2$
μ^-	=	$\frac{1}{3}(\frac{-12}{6} + \frac{-12}{6} + \frac{-3}{6})$	= $\frac{1}{3}(\frac{-27}{6})$	=	$-3/2$
τ^-	=	$\frac{1}{3}(\frac{-18}{6} + \frac{-18}{6} + \frac{-9}{6})$	= $\frac{1}{3}(\frac{-45}{6})$	=	$-5/2$

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Consequently from Gell-mann-Nishijima Relation (1), and Table3 & Table4, we obtain Table5 & Table6, that can explain the puzzles [3] of I_3 isospin, electric charge Q hypercharge Y for elementary fermions.

Table 5: Quantum numbers for quarks in SM & STS

Quark SM	T	T_3	Q	Y	||	I	I_3	Q	Y	Quark STS
t	0	0	+2/3	+4/3	||	1/2	+5/2	+2/3	−11/3	t
c	0	0	+2/3	+4/3	||	1/2	+3/2	+2/3	−5/3	c
u	1/2	+1/2	+2/3	+1/3	||	1/2	+1/2	+2/3	+1/3	u
d	1/2	−1/2	−1/3	+1/3	||	1/2	−1/2	−1/3	+1/3	d
s	0	0	−1/3	−2/3	||	1/2	−3/2	−1/3	+7/3	s
b	0	0	−1/3	−2/3	||	1/2	−5/2	−1/3	+13/3	b

Table 6: Quantum numbers for leptons in SM & STS

Lepton SM	T	T_3	Q	Y	||	I	I_3	Q	Y	Lepton STS
υ_τ	1/2	+1/2	0	−1	||	1/2	+5/2	0	−5	υ_τ
υ_μ	1/2	+1/2	0	−1	||	1/2	+3/2	0	−3	υ_μ
υ_e	1/2	+1/2	0	−1	||	1/2	+1/2	0	−1	υ_e
e^-	1/2	−1/2	−1	−1	||	1/2	−1/2	−1	−1	e^-
μ^-	1/2	−1/2	−1	−1	||	1/2	−3/2	−1	+1	μ^-
τ^-	1/2	−1/2	−1	−1	||	1/2	−5/2	−1	+3	τ^-

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2. Color of Electric Charge, Color of Hypercharge

Transform (1) into (6), get the color representations of Gell-mann-Nishijima Relation for particles below

$$Q = T_3 + \tfrac{1}{2}Y \tag{1}$$

$$\mathbf{Q} = \mathbf{I}_3 + \tfrac{1}{2}\mathbf{Y} \tag{6}$$

Notation: now, *the scripts* of *color representation* of particle quantum numbers are written by *bold* shown below

Where for quarks

$$\mathbf{Q} = \mathbf{Q}(q) = (\mathbf{Q}q_{\mathrm{R}}, \mathbf{Q}q_{\mathrm{G}}, \mathbf{Q}q_{\mathrm{B}}) \tag{7}$$

$$\mathbf{I}_3 = \mathbf{I}_3(q) = (q_{\mathrm{R}}, q_{\mathrm{G}}, q_{\mathrm{B}}) \tag{8}$$

$$\mathbf{Y} = \mathbf{Y}(q) = (\mathbf{Y}q_{\mathrm{R}}, \mathbf{Y}q_{\mathrm{G}}, \mathbf{Y}q_{\mathrm{B}}) \tag{9}$$

Where for leptons

$$\mathbf{Q} = \mathbf{Q}(l) = (\mathbf{Q}l_{\mathrm{R}}, \mathbf{Q}l_{\mathrm{G}}, \mathbf{Q}l_{\mathrm{B}}) \tag{10}$$

$$\mathbf{I}_3 = \mathbf{I}_3(l) = (l_{\mathrm{R}}, l_{\mathrm{G}}, l_{\mathrm{B}}) \tag{11}$$

$$\mathbf{Y} = \mathbf{Y}(l) = (\mathbf{Y}l_{\mathrm{R}}, \mathbf{Y}l_{\mathrm{G}}, \mathbf{Y}l_{\mathrm{B}}) \tag{12}$$

$\mathbf{Q}, \mathbf{I}_3, \mathbf{Y}$ are three demensional color representation. Formulas, (7) to (12), are color representations of $\mathbf{Q}, \mathbf{I}_3, \mathbf{Y}$ in Real Number Field $\mathbb{R}$. An example of $\mathbf{Q}$ (10) $\mathbf{I}_3$ (11) $\mathbf{Y}$ (12) for electron e^- of lepton l is given below

$$\mathbf{Q}(e^-) = (\mathbf{Q}e^-_{\mathrm{R}}, \mathbf{Q}e^-_{\mathrm{G}}, \mathbf{Q}e^-_{\mathrm{B}}) = (-1, -1, -1) \tag{10.1}$$

$$\mathbf{I}_3(e^-) = (e^-_{\mathrm{R}}, e^-_{\mathrm{G}}, e^-_{\mathrm{B}}) = (\tfrac{-6}{6}, \tfrac{-6}{6}, \tfrac{+3}{6}) \tag{11.1}$$

$$\mathbf{Y}(e^-) = (\mathbf{Y}e^-_{\mathrm{R}}, \mathbf{Y}e^-_{\mathrm{G}}, \mathbf{Y}e^-_{\mathrm{B}}) = (\tfrac{0}{3}, \tfrac{0}{3}, \tfrac{-9}{3}) \tag{12.1}$$

And the observable values of the above three color operators for electron e^- are given below

$$Q(e^-) = \frac{1}{3}\{ (-1) + (-1) + (-1) \} = -1 \tag{10.2}$$

$$I_3(e^-) = \frac{1}{3}\{ (\frac{-6}{6}) + (\frac{-6}{6}) + (\frac{+3}{6}) \} = \frac{1}{3}\{ \frac{-9}{6} \} = \frac{-1}{2} \tag{11.2}$$

$$Y(e^-) = \frac{1}{3}\{ (\frac{0}{3}) + (\frac{0}{3}) + (\frac{-9}{3}) \} = \frac{1}{3}\{ \frac{-9}{3} \} = -1 = Y_L(e) \tag{12.2}$$

The above results are satisfied with Gell-mann-Nishijima Relation (1) and (6) shown below

For (1)

$$Q(e^-) = T_3(e^-) + \frac{1}{2} Y(e^-)$$

$$-1 = \frac{-1}{2} + \frac{1}{2}(-1) \tag{13.1}$$

For (6)

$$\mathbf{Q} = \mathbf{I}_3 + \frac{1}{2}\mathbf{Y}$$

$$(-1,-1,-1) = (\frac{-6}{6}, \frac{-6}{6}, \frac{+3}{6}) + \frac{1}{2}(\frac{0}{3}, \frac{0}{3}, \frac{-9}{3}) = (\frac{-6}{6}, \frac{-6}{6}, \frac{+3}{6}) + (\frac{0}{6}, \frac{0}{6}, \frac{-9}{6}) \tag{13.2}$$

3. Q^2 Scalar Product of Electric Charge Q

In order to research the mess of particles, an key concept, *Scalar Product of Electric Charge* $\mathbf{Q}^2$ of color operator $\mathbf{Q}$, is introduced. In real number field $\mathbb{R}$, we have

- For quark

$$\mathbf{Q}^2(q) = \mathbf{Q}(q) \cdot \mathbf{Q}(q) = (\mathbf{Q}q_\mathrm{R}, \mathbf{Q}q_\mathrm{G}, \mathbf{Q}q_\mathrm{B})^2 = \mathbf{Q}^2 q_\mathrm{R} + \mathbf{Q}^2 q_\mathrm{G} + \mathbf{Q}^2 q_\mathrm{B} \tag{14.1}$$

- For lepton

$$\mathbf{Q}^2(l) = \mathbf{Q}(l) \cdot \mathbf{Q}(l) = (\mathbf{Q}l_\mathrm{R}, \mathbf{Q}l_\mathrm{G}, \mathbf{Q}l_\mathrm{B})^2 = \mathbf{Q}^2 l_\mathrm{R} + \mathbf{Q}^2 l_\mathrm{G} + \mathbf{Q}^2 l_\mathrm{B} \tag{14.2}$$

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We extend color representation (7) (8) (9) **Q** for quark (as well as for lepton l (10) (11) (12) and for boson B) from real number field $\mathbb{R}(\xi=0)$ to complex number field $\mathbb{C}(\xi)$

$$\mathbf{Q}(q) \Rightarrow \mathbf{Q}(q,\xi) = \mathbf{Q}(q+i\xi) = (\mathbf{Q}q_{\mathrm{R}}, \mathbf{Q}q_{\mathrm{G}}, \mathbf{Q}q_{\mathrm{B}})_{\xi\neq 0} + i(\xi_{\mathrm{R}}, \xi_{\mathrm{G}}, \xi_{\mathrm{B}}) \tag{15}$$

Where

$$\mathbf{Q}(q+i\xi) = (\mathbf{Q}q_{\mathrm{R}}+i\xi_{\mathrm{R}},\ \mathbf{Q}q_{\mathrm{G}}+i\xi_{\mathrm{G}},\ \mathbf{Q}q_{\mathrm{B}}+i\xi_{\mathrm{B}}) \tag{15.1}$$

$$\mathbf{Q}(q)_{\xi\neq 0} = (\mathbf{Q}q_{\mathrm{R}}, \mathbf{Q}q_{\mathrm{G}}, \mathbf{Q}q_{\mathrm{B}})_{\xi\neq 0} \tag{15.2}$$

$$\boldsymbol{\xi}(q) = (\xi_{\mathrm{R}}, \xi_{\mathrm{G}}, \xi_{\mathrm{B}}) \tag{15.3}$$

then square of (15)

$$\mathbf{Q}^2(q,\xi) = \mathbf{Q}^2 = \mathrm{Re}\mathbf{Q}^2 + i\,\mathrm{Im}\mathbf{Q}^2 \tag{16}$$

$$\mathrm{Re}\mathbf{Q}^2 \equiv \mathbf{Q}^2(q)_{\xi\neq 0} - \boldsymbol{\xi}^2(q) \tag{17}$$

$$\mathrm{Im}\mathbf{Q}^2 \equiv 2\mathbf{Q}(q)_{\xi\neq 0} \cdot \boldsymbol{\xi}(q) \tag{18}$$

- **Scalar Product inequality of Electric Charge Q:** The value of $\mathbf{Q}^2(q)_{\xi\neq 0}$ always is greater than that of $\mathbf{Q}^2(q)_{\xi=0}$

$$\mathbf{Q}^2(q)_{\xi\neq 0} > \mathbf{Q}^2(q)_{\xi=0} \tag{19}$$

it means: the particles excited that stay with $\xi \neq 0$ in complex number field $\mathbb{C}(\xi)$, would always are in a unstabler state compared with those, ground states, with $\xi=0$ in real number field $\mathbb{R}$; AND the other term $\mathrm{Im}\mathbf{Q}^2$ (18), the imaginary part of $\mathbf{Q}^2$ (16) implies that the unstabler particles are always fluctuating.

The physical picture of inequality (19) is an impartant role used frequently in this paper.

4. $Q(e^-,\xi)$, Color of Electric Charge of Electron e^- in Complex Number Field $\mathbb{C}$

Now discuss a special case of (16) for lepton electron e^- following

$$\mathbf{Q}^2(e^-,\xi(e^-)) = \mathrm{Re}\mathbf{Q}^2(e^-,\xi(e^-)) + i\,\mathrm{Im}\mathbf{Q}^2(e^-,\xi(e^-)) \tag{20}$$

As electron e^- is the most stable charged particle, $\mathbf{Q}^2(e^-,\xi(e^-))$ is scaled as below

$$\mathrm{Re}\mathbf{Q}^2(e^-,\xi(e^-)) = 1 \tag{21}$$

$$\mathrm{Im}\mathbf{Q}^2(e^-,\xi(e^-)) = 0 \tag{22}$$

Base on (23) (24) below, the requiments (21) & (22) can be satisfied

$$\mathbf{Q}(e^-,\xi(e^-)=\tfrac{\pm1}{\sqrt{3}}) = (-1,-1,-1) + i\,(\tfrac{\pm1}{\sqrt{3}},\tfrac{\pm1}{\sqrt{3}},\tfrac{\mp2}{\sqrt{3}}) \tag{23}$$

$$Q(e^-,\xi(e^-)=\tfrac{\pm1}{\sqrt{3}}) = \tfrac{1}{3}\{-1-1-1+i\,(\tfrac{\pm1}{\sqrt{3}}+\tfrac{\pm1}{\sqrt{3}}+\tfrac{\mp2}{\sqrt{3}})\} = -e \tag{24}$$

then yields

$$\begin{aligned}\mathrm{Re}\mathbf{Q}^2(e^-,\xi(e^-)=\tfrac{\pm1}{\sqrt{3}}) &= (-1,-1,-1)^2 - (\tfrac{\pm1}{\sqrt{3}},\tfrac{\pm1}{\sqrt{3}},\tfrac{\mp2}{\sqrt{3}})^2\\ &= 3 - \tfrac{6}{3} = 3-2 = 1\end{aligned} \tag{25}$$

$$\begin{aligned}\mathrm{Im}\mathbf{Q}^2(e^-,\xi=\tfrac{\pm1}{\sqrt{3}}) &= 2(-1,-1,-1)\,(\tfrac{\pm1}{\sqrt{3}},\tfrac{\pm1}{\sqrt{3}},\tfrac{\mp2}{\sqrt{3}})\\ &= -2(\tfrac{\pm1}{\sqrt{3}}+\tfrac{\pm1}{\sqrt{3}}+\tfrac{\mp2}{\sqrt{3}}) = 0\end{aligned} \tag{26}$$

Last (20) becomes

$$\mathbf{Q}^2(e^-) = \mathbf{Q}^2(e^-,\xi(e^-)) = \mathrm{Re}\mathbf{Q}^2(e^-,\xi(e^-) + i\,\mathrm{Im}\mathbf{Q}^2(e^-,\xi(e^-) = 1 \tag{27}$$

$\mathbf{Q}^2(e^-)$ is called *Scaling Factor*. (23) (27) are important formulas in following discussions.

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Part. B: Mass Principle

5. Mass Principle

Particle mass M is propertional to Scalar Product $\mathbf{Q}^2$ of Electric Charge $\mathbf{Q}$ of the particle

Postulate

$$M^{\kappa}(q) \propto \mathbf{Q}^2(q) \quad (28)$$

$$M^{\lambda}(l) \propto \mathbf{Q}^2(l) \quad (29)$$

$$M^{\eta}(B) \propto \mathbf{Q}^2(B) \quad (30)$$

Here: $\mathbf{Q}(q)$, $\mathbf{Q}(l)$ and $\mathbf{Q}(B)$ are color representations of quarks, leptons and bosons. $M^{\kappa}(q)$, $M^{\lambda}(l)$ and $M^{\lambda}(B)$ are masses of quarks, leptons and bosons which are proportional to to *Scalar Product* $\mathbf{Q}^2(q)$, $\mathbf{Q}^2(l)$ and $\mathbf{Q}^2(B)$. Now we focus on case of $\kappa = \lambda = \eta = 1$.

6. Scaling Factor $Q^2(e^-)$

- Due to (27) and (29), we have electron mass

$$M\,(e^-) \;=\; \mathbf{Q}^2(e^-)\,0.511 Mev \;=\; 0.511 Mev \tag{31}$$

and

$$\frac{M(e^-)}{\mathbf{Q}^2(e^-)} \;=\; 0.511 \tag{32}$$

- Rewrite (28) (29) (30) as expression (33) below

$$M(\alpha) \;\propto\; \mathbf{Q}^2(\alpha) \quad\Rightarrow\; M(\alpha) \;=\; \frac{\mathbf{Q}^2(\alpha)}{\mathbf{Q}^2(e^-)} \cdot M(e^-) \;=\; \mathbf{Q}^2(\alpha)\,\frac{M(e^-)}{\mathbf{Q}^2(e^-)} \;=\; \mathbf{Q}^2(\alpha)\,\frac{M(e^-)}{\mathbf{1}} \;=\; \mathbf{Q}^2(q) M(e^-) \tag{33}$$

where $\alpha \;=\; q, l, B$

OR

$$M(\alpha) \;=\; \mathbf{Q}^2(\alpha)\,M(e^-) \tag{34}$$

Further in complex number field $\mathbb{C}$, we have the extensions of (28) (29) (30) following

$$M(q,\xi) \;=\; \mathbf{Q}^2(q,\xi)\,M(e^-) \;=\; 0.511\mathbf{Q}^2(q,\xi)\;\; Mev \tag{35.1}$$

$$M(l,\xi) \;=\; \mathbf{Q}^2(l,\xi)\,M(e^-) \;=\; 0.511\mathbf{Q}^2(l,\xi)\;\; Mev \tag{35.2}$$

$$M(B,\xi) \;=\; \mathbf{Q}^2(B,\xi)\,M(e^-) \;=\; 0.511\mathbf{Q}^2(B,\xi)\;\; Mev \tag{35.3}$$

Formulas (35.1) (35.2) (35.3) could offer the relationship between particle experimental masses M and scalar pdoducts $\mathbf{Q}^2$ of particle.

So far we have elaborated the logistic route for *Mass Principle.*

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Part. C: Origins of Neutrino Masses

7. Color Representation of Gell-mann-Nishijima Relation for Neutrinos υ_e , υ_μ, υ_τ

- For **Neutrino** υ_e

$$\mathbf{Q}(\upsilon_e) = (\ +0.000\ 807\ 6578,\ \ +0.000\ 807\ 6578,\ \ -0.001\ 615\ 3156\ )$$

$$\mathbf{I}_3(\upsilon_e) = (\tfrac{-2}{6}, \tfrac{+1}{6}, \tfrac{+10}{6})$$

$$\mathbf{Q}(\upsilon_e) - \mathbf{I}_3(\upsilon_e) = (\ +0.334\ 140\ 9911,\ \ -0.165\ 859\ 0089,\ \ -1.668\ 281\ 9823\ )$$

$$\mathbf{Y}(\upsilon_e) = 2(\mathbf{Q}(\upsilon_e) - \mathbf{I}_3(\upsilon_e))$$

$$\mathbf{Y}(\upsilon_e) = (\ +0.668.281\ 98220,\ \ -0.331\ 718\ 01770,\ \ -3.336\ 563\ 96450\ ) \quad (36.1)$$

$$Y(\upsilon_e) = \tfrac{1}{3}(\ +0.668.281\ 9822 - 0.331\ 718\ 0177 - 3.336\ 563\ 9645\ ) = \tfrac{1}{3}(\ -3.000\ 000\ 0000\ ) = -1 \quad (36.2)$$

$$\mathbf{I}_3(\upsilon_e) = (\tfrac{-2}{6}, \tfrac{+1}{6}, \tfrac{+10}{6}) \quad (36.3)$$

$$\tfrac{1}{2}\mathbf{Y}(\upsilon_e) = (\ +0.334.140\ 9911,\ \ -0.165\ 859\ 00885,\ \ -1.668\ 281\ 98225\ ) \quad (36.4)$$

$$\mathbf{Q}(\upsilon_e) = \mathbf{I}_3(\upsilon_e) + \tfrac{1}{2}\mathbf{Y}(\upsilon_e) = (\ +0.000\ 807\ 6578,\ \ +0.000\ 807\ 6578,\ \ -0.001\ 615\ 3156\ )$$

$$\mathbf{Q}(\upsilon_e) = (\ +0.000\ 807\ 6578,\ \ +0.000\ 807\ 6578,\ \ -0.001\ 615\ 3156\ ) \quad (36.5)$$

$$\mathbf{Q}^2(\upsilon_e) = 0.000\ 003\ 9138 = \frac{0.000\ 0020}{0.511} \quad (36.6)$$

- For **Neutrino** υ_μ

$$\mathbf{Q}(\upsilon_\mu) = (\ +0.248\ 937\ 7301,\ \ +0.248\ 937\ 7301,\ \ -0.497\ 875\ 4602\ )$$

$$\mathbf{I}_3(\upsilon_\mu) = (\tfrac{-8}{6},\ \tfrac{-5}{6},\ \tfrac{+40}{6})$$

$$\mathbf{Q}(\upsilon_\mu) - \mathbf{I}_3(\upsilon_\mu) = (\ +1.582\ 271\ 0634,\ \ +1.082\ 271\ 0634,\ \ -7.164\ 542\ 1269\ )$$

$$\mathbf{Y}(\upsilon_\mu) = 2(\mathbf{Q}(\upsilon_\mu) - \mathbf{I}_3(\upsilon_\mu))$$

$$\mathbf{Y}(\upsilon_\mu) = (\ +3.164\ 542\ 1268,\ \ +2.164\ 542\ 1268,\ \ -14.329\ 084\ 2538\ ) \tag{37.1}$$

$$Y(\upsilon_\mu) = \tfrac{1}{3}(\ +3.164\ 542\ 1268\ +2.164\ 542\ 1268\ -14.329\ 084\ 2538\ ) = \tfrac{1}{3}(\ -9.000\ 000\ 0002\ )$$

$$= -3.000\ 000\ 0001 \approx -3 \tag{37.2}$$

$$\mathbf{I}_3(\upsilon_\mu) = (\tfrac{-8}{6},\ \tfrac{-5}{6},\ \tfrac{+40}{6}) \tag{37.3}$$

$$\tfrac{1}{2}\mathbf{Y}(\upsilon_\mu) = (\ +1.582\ 271\ 0634,\ \ +1.082\ 271\ 0634,\ \ -7.164\ 542\ 1269\ ) \tag{37.4}$$

$$\mathbf{Q}(\upsilon_\mu) = \mathbf{I}_3(\upsilon_\mu) + \tfrac{1}{2}\mathbf{Y}(\upsilon_\mu) = (\ +0.248\ 937\ 7301,\ \ +0.248\ 937\ 7301,\ \ -0.497\ 875\ 4602\ )$$

$$\mathbf{Q}(\upsilon_\mu) = (\ +0.248\ 937\ 7301,\ \ +0.248\ 937\ 7301,\ \ -0.497\ 875\ 4602\ ) \tag{37.5}$$

$$\mathbf{Q}^2(\upsilon_\mu) = 0.371\ 819\ 9609 = \frac{0.190\ 000\ 0001}{0.511} \tag{37.6}$$

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- For **Neutrino** υ_τ

$$\mathbf{Q}(\upsilon_\tau) = (\ +2.436\ 405\ 7666,\ \ +2.436\ 405\ 7666,\ \ -4.872\ 811\ 5332\ )$$

$$\mathbf{I}_3(\upsilon_\tau) = (\tfrac{-26}{6},\ \tfrac{-23}{6},\ \tfrac{+94}{6})$$

$$\mathbf{Q}(\upsilon_\tau) - \mathbf{I}_3(\upsilon_\tau) = (\ +6.769\ 739\ 0999,\ \ +6.269\ 739\ 0999,\ \ -20.539\ 478\ 1999\ )$$

$$\mathbf{Y}(\upsilon_\tau) = 2(\mathbf{Q}(\upsilon_\tau) - \mathbf{I}_3(\upsilon_\tau))$$

$$\mathbf{Y}(\upsilon_\tau) = (\ +13.539\ 478\ 1998,\ \ +12.539\ 478\ 1998,\ \ -41.078\ 956\ 3998\ ) \tag{38.1}$$

$$Y(\upsilon_\tau) = \tfrac{1}{3}(\ +13.539\ 478\ 1998\ +12.539\ 478\ 1998\ -41.078\ 956\ 3998\ ) = \tfrac{1}{3}(\ -15.000\ 000\ 0002\ )$$

$$= -5.000\ 000\ 0001 \approx -5 \tag{38.2}$$

$$\mathbf{I}_3(\upsilon_\tau) = (\tfrac{-26}{6},\ \tfrac{-23}{6},\ \tfrac{+94}{6}) \tag{38.3}$$

$$\tfrac{1}{2}\mathbf{Y}(\upsilon_\tau) = (\ +6.769\ 739\ 0999,\ \ +6.269\ 739\ 0999,\ \ -20.539\ 478\ 1999\ ) \tag{38.4}$$

$$\mathbf{Q}(\upsilon_\tau) = \mathbf{I}_3(\upsilon_\tau) + \tfrac{1}{2}\mathbf{Y}(\upsilon_\tau) = (\ +2.436\ 405\ 7666,\ \ +2.436\ 405\ 7666,\ \ -4.872\ 811\ 5332\ )$$

$$\mathbf{Q}(\upsilon_\tau) = (\ +2.436\ 405\ 7666,\ \ +2.436\ 405\ 7666,\ \ -4.872\ 811\ 5332\ ) \tag{38.5}$$

$$\mathbf{Q}^2(\upsilon_\tau) = 35.616\ 438\ 3571 = \frac{18.200\ 000\ 0005}{0.511} \tag{38.6}$$

Summary of Neutrino Masses (Ground State)

$$\mathbf{Q}(\upsilon_\tau) = (\ +2.436\ 405\ 7666,\ +2.436\ 405\ 7666,\ -4.872\ 811\ 5332\ ) \quad (38.5)$$

$$\mathbf{Q}(\upsilon_\mu) = (\ +0.248\ 937\ 7301,\ +0.248\ 937\ 7301,\ -0.497\ 875\ 4602\ ) \quad (37.5)$$

$$\mathbf{Q}(\upsilon_e) = (\ +0.000\ 807\ 6578,\ +0.000\ 807\ 6578,\ -0.001\ 615\ 3156\ ) \quad (36.5)$$

$$\mathbf{Q}^2(\upsilon_\tau) = 35.616\ 438\ 3571 = \frac{18.200\ 000\ 0005}{0.511} \quad (38.6)$$

$$\mathbf{Q}^2(\upsilon_\mu) = 0.371\ 819\ 9609 = \frac{0.190\ 000\ 0001}{0.511} \quad (37.6)$$

$$\mathbf{Q}^2(\upsilon_e) = 0.000\ 003\ 9138 = \frac{0..000\ 0020}{0.511} \quad (36.6)$$

$$\mathbf{Q}(\upsilon_\tau)\mathbf{Q}(\upsilon_\mu) = 3.639\ 079\ 9266 = \frac{1.859\ 569\ 8425}{0.511}$$

$$\mathbf{Q}(\upsilon_\mu)\mathbf{Q}(\upsilon_e) = 0.000\ 201\ 0565 = \frac{0.000\ 102\ 7399}{0.511}$$

$$\mathbf{Q}(\upsilon_e)\mathbf{Q}(\upsilon_\tau) = 0.001\ 967\ 7821 = \frac{0.001\ 005\ 5367}{0.511}$$

$$\mathbf{I}_3(\upsilon_\tau) = (\ \tfrac{-26}{6},\ \tfrac{-23}{6},\ \tfrac{+94}{6}\ ) \quad (38.3)$$

$$\mathbf{I}_3(\upsilon_\mu) = (\ \tfrac{-8}{6},\ \tfrac{-5}{6},\ \tfrac{+40}{6}\ ) \quad (37.3)$$

$$\mathbf{I}_3(\upsilon_e) = (\ \tfrac{-2}{6},\ \tfrac{+1}{6},\ \tfrac{+10}{6}\ ) \quad (36.3)$$

$$\mathbf{Y}(\upsilon_\tau) = (\ +13.539\ 478\ 1998,\ \ +12.539\ 478\ 1998,\ \ -41.078\ 956\ 3998\ ) \quad (38.1)$$

$$\mathbf{Y}(\upsilon_\mu) = (\ +3.164\ 542\ 1268,\ \ +2.164\ 542\ 1268,\ \ -14.329\ 084\ 2538\ ) \quad (37.1)$$

$$\mathbf{Y}(\upsilon_e) = (\ +0.668.281\ 98220,\ \ -0.331\ 718\ 01770,\ \ -3.336\ 563\ 96450\ ) \quad (36.1)$$

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Part. D: Elementary Fermion Observed Mass Spectrum (Ground State)

- **Color of quarks**

$$\mathbf{Q}(t) = (+238.206\ 321\ 5198,\ +238.206\ 321\ 5198,\ -474.412\ 643\ 0396) \quad (39.1)$$

$$\mathbf{Q}(c) = (+21.093\ 605\ 7202,\ +21.093\ 605\ 7202,\ -40.187\ 211\ 4404) \quad (39.2)$$

$$\mathbf{Q}(u) = (+1.393\ 262\ 0539,\ +1.393\ 262\ 0539,\ -0.786\ 524\ 1078) \quad (39.3)$$

$$\mathbf{Q}(d) = (-1.562\ 154\ 7908,\ -1.562\ 154\ 7908,\ +2.124\ 309\ 5816) \quad (39.4)$$

$$\mathbf{Q}(s) = (-5.894\ 757\ 7177,\ -5.894\ 757\ 7177,\ +10.789\ 515\ 4354) \quad (39.5)$$

$$\mathbf{Q}(b) = (-39.485\ 426\ 3597,\ -39.485\ 426\ 3597,\ +77.970\ 852\ 7194) \quad (39.6)$$

- **Color of leptons**

$$\mathbf{Q}(\upsilon_\tau) = (+2.436\ 405\ 7666,\ +2.436\ 405\ 7666,\ -4.872\ 811\ 5332) \quad (40.1)$$

$$\mathbf{Q}(\upsilon_\mu) = (+0.248\ 937\ 7301,\ +0.0.248\ 937\ 7301,\ -0.497\ 875\ 4602) \quad (40.2)$$

$$\mathbf{Q}(\upsilon_e) = (+0.000\ 807\ 6578,\ +0.000\ 807\ 6578,\ -0.001\ 615\ 3156) \quad (40.3)$$

$$\mathbf{Q}(e^-, \xi) = (-1.000\ 000\ 000,\ -1.000\ 000\ 000,\ -1.000\ 000\ 000) + i\left(\frac{\pm 1}{\sqrt{3}}, \frac{\pm 1}{\sqrt{3}}, \frac{\mp 2}{\sqrt{3}} \right) \quad (40.4)$$

$$\mathbf{Q}(\mu^-) = (-6.828\ 797\ 9759,\ -6.828\ 797\ 9759,\ +10.657\ 595\ 9518) \quad (40.5)$$

$$\mathbf{Q}(\tau^-) = (-25.064\ 133\ 4342,\ -25.064\ 133\ 4342,\ +47.128\ 266\ 8684) \quad (40.6)$$

THEN

$$\mathbf{Q}^2(t) = 338,551.859\ 099\ 9027 = \frac{173,000.000\ 000\ 0017}{0.511} \tag{41.1}$$

$$\mathbf{Q}^2(c) = 2,504.892\ 367\ 8975 = \frac{1,280.000\ 000\ 0041}{0.511} \tag{41.2}$$

$$\mathbf{Q}^2(u) = 4.500\ 978\ 4756 = \frac{2.300\ 000\ 0001}{0.511} \tag{41.3}$$

$$\mathbf{Q}^2(d) = 9.393\ 346\ 3803 = \frac{4.799\ 999\ 9998}{0.511} \tag{41.4}$$

$$\mathbf{Q}^2(s) = 185.909\ 980\ 4292 = \frac{95.000\ 000\ 0005}{0.511} \tag{41.5}$$

$$\mathbf{Q}^2(b) = 9,197.651\ 663\ 3893 = \frac{4,700.000\ 000\ 0000}{0.511} \tag{41.6}$$

$$\mathbf{Q}^2(\upsilon_\tau) = 35.616\ 438\ 3571 = \frac{18.200\ 000\ 0005}{0.511} \tag{42.1}$$

$$\mathbf{Q}^2(\upsilon_\mu) = 0.371\ 819\ 9609 = \frac{0.190}{0.511} \tag{42.2}$$

$$\mathbf{Q}^2(\upsilon_e) = 0.000\ 003\ 9138 = \frac{0..000\ 002}{0.511} \tag{42.3}$$

$$\mathbf{Q}^2(e^-) = 1.000\ 000\ 0000 = \frac{0.511\ 000\ 0000}{0.511} \tag{42.4}$$

$$\mathbf{Q}^2(\mu^-) = 206.849\ 315\ 0632 = \frac{105.699\ 999\ 9973}{0.511} \tag{42.5}$$

$$\mathbf{Q}^2(\tau^-) = 3,477.495\ 107\ 6339 = \frac{1,777.000\ 000\ 0009}{0.511} \tag{42.6}$$

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Part. E: Origins of Mass of Scalar Higgs Boson h and Massless Bosons by Color-Pair

8. Boson Particle Color Mechanism

In this paragraph we begin to research the mass origins of Boson Particles. According to Mass Priciple, obviously how to find out the color representation $\mathbf{Q}(Boson)$ of boson particles is the first step.

We presume a color mechanism for giving rise to color of boson particle $\mathbf{Q}(B)$ below

Presumption

$$\boxed{\mathbf{Q}(B) = \mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})} \tag{43}$$

- Where *Color-Pair* $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})$ is defined as

$$\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}) = \mathbf{Q}(\mathrm{F},\xi) + \mathbf{Q}(\overline{\mathrm{F}},\xi) \tag{44}$$

That constructed from two fermions with two opposite imaginary color ξ between $\mathbf{Q}(\mathrm{F},\xi)$ and $\mathbf{Q}(\overline{\mathrm{F}},\xi)$ each other below

$$\mathbf{Q}(\mathrm{F},\xi) = \mathbf{Q}(\mathrm{F}) + i\,\xi \tag{45}$$

$$\mathbf{Q}(\overline{\mathrm{F}},\xi) = \mathbf{Q}(\overline{\mathrm{F}}) - i\,\xi \tag{46}$$

Color representation of a boson particle is expressed by $\mathbf{Q}(B)$ that is presumed to be a " bound state " constructed of so-called color-pair $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})$ (44)

$$\mathbf{Q}(B) = \mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}) = \mathbf{Q}(\mathrm{F},\xi) + \mathbf{Q}(\overline{\mathrm{F}},\xi) = (\ \mathbf{Q}(\mathrm{F}) + i\,\xi\ ) + (\ \mathbf{Q}(\overline{\mathrm{F}}) - i\,\xi\ ) = \mathbf{Q}(\mathrm{F}) + \mathbf{Q}(\overline{\mathrm{F}}) = \mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}) \tag{47}$$

9. $Y(h)$, Color Representation of Hypercharge Y of Higgs Doublet Φ

In the SM, h Higgs boson is a highly unusual particle that is zero spin, a unique scalar neutral boson as known. Higgs boson is not a gauge boson, its mass is obtained by experiments, but we could use Higgs doublet Φ and Higgs field $h(x)$, which are related to the excitations of vacuum associated with the Higgs boson. In SM the value of hypercharge of Higgs doublet Φ is $+1$ below [4]

Using Gell-mann-Nishijima Relation (1), get the hypercharge value (49) of Φ

$$Y = 2(Q - T_3) \tag{48}$$

$$Y(h)\,\Phi = 2(Q - T_3)\begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix} = 2\begin{pmatrix} [\,1 - (\frac{+1}{2})]\,\phi^+ \\ [\,0 - (\frac{-1}{2})]\,\phi^0 \end{pmatrix} = +1\,\Phi \tag{49}$$

• Contrary to (48), in STS space, the hypercharge of Higgs particle h is personified as a *color operator* $\mathbf{Y}(h)$ that transferred from *C number* $Y(h)$, and because of (47), we get (50)

$$Y(h) \quad \Rightarrow \quad \mathbf{Y}(h) = 2(\,\mathbf{Q}(h) - \mathbf{I}_3(h)\,) = 2(\,\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}) - \mathbf{I}_3(h)\,) \tag{50}$$

We find: If the two terms, color-pair $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})$ & isospin $\mathbf{I}_3(h)$, of (50) are satisfied the following conditions (51) & (52) and (53) & (54) respectively, expression $\mathbf{Y}(h)$ (50) could directly give the result (57) that as same as Higgs doublet Φ did with (49) following

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- The values of Color Pair is given by

$$\mathbf{Q}(\mathrm{F\overline{F}}) = (202, \ 202, \ -404) \tag{51}$$

$$\mathbf{Q}^2(\mathrm{F\overline{F}}) = 244,824 = \frac{125{,}105.064}{0.511} \approx \frac{125{,}000.000}{0.511} = \frac{M(h)}{M(e^-)} \tag{52}$$

- Color isospin $\mathbf{I}_3(h)$ of Higgs particle (Ref. Table10.2 below) is given by

$$\mathbf{I}_3(h) = (h_\mathrm{R}, h_\mathrm{G}, h_\mathrm{B}) = \left(\tfrac{-3}{4}, 0, \tfrac{-3}{4}\right) \tag{53}$$

$$I_3(h) = \tfrac{1}{3}\left(\tfrac{-3}{4} + 0 + \tfrac{-3}{4}\right) = \tfrac{1}{3}\left(\tfrac{-3}{2}\right) = \tfrac{-1}{2} \tag{54}$$

Then substitue (51) & (53) into (50), obtain color of hypercharge of Higgs oarticle h (55) (56) below

$$\mathbf{Y}(h) = 2(\ \mathbf{Q}(\mathrm{F\overline{F}}) - \mathbf{I}_3(h)\ ) = 2(\ (202, \ 202, \ -404) - \left(\tfrac{-3}{4}, 0, \tfrac{-3}{4}\right)\ ) \tag{55}$$

$$= 2(\ (\ +202.75, \ +202, \ -403.25\ )\ ) = (\ +405.5, \ +404, \ -806.5\ )$$

Last obtain

$$\mathbf{Y}(h) = (\ +405.5, \ +404, \ -806.5\ ) \tag{56}$$

$$Y(h) = \tfrac{1}{3}(\ +405.5 + 404 - 806.5\ ) = \tfrac{1}{3}(\ 3\ ) = 1 \tag{57}$$

Next putting isospin $\mathbf{I}_3(h)$ (53) and hypercharge $\mathbf{Y}(h)$ (56) into color representations of Gell-mann-Nishijima Relation (6) for Higgs particle h, then we obtain Color of Electric Charge $\mathbf{Q}(h)$ (60) (61) of Higgs below

$$\mathbf{Q}(h) \;=\!` \mathbf{I}_3(h) + \tfrac{1}{2}\mathbf{Y}(h) \tag{58}$$

$$= \left(\tfrac{-3}{4},\; 0,\; \tfrac{-3}{4} \right) + \tfrac{1}{2}\left(+405.5,\; +404,\; -806.5 \right)$$

$$= \left(-0.75,\; 0,\; -0.75 \right) + \left(+202.75,\; +202,\; -403.25 \right) = \left(+202,\; +202,\; -404 \right) \tag{59}$$

$$\mathbf{Q}(h) = \left(+202,\; +202,\; -404 \right) \tag{60}$$

$$Q(h) = \tfrac{1}{3}\left(+202 + 202 - 404 \right) = 0\, e \tag{61}$$

Compairing (60) with $\mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})$ (51), we have

$$\mathbf{Q}(h) = \mathbf{Q}(\mathrm{F}\overline{\mathrm{F}}) \tag{62}$$

$$\mathbf{Q}^2(h) = \mathbf{Q}^2(\mathrm{F}\overline{\mathrm{F}}) = 244,824 \tag{63}$$

Formulas (63) (52) shows: mass $M(h)$ of Higgs boson h could directly be otained by (64), as long as (63) is a valid guy.

$$M(h) = \mathbf{Q}^2(h)\, M(e^-) = \mathbf{Q}^2(\mathrm{F}\overline{\mathrm{F}})\, M(e^-) \tag{64}$$

More details about formuls (63) and the extension story will be continued in next paragraph, we will use formula $\mathbf{Q}(\mathrm{F},\xi) + \mathbf{Q}(\overline{\mathrm{F}},\xi) = \mathbf{Q}(\mathrm{F}\overline{\mathrm{F}})$ to get a nicer $\mathbf{Q}^2(h)$ that better than (63).

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10. Calculating Mass $M(h)$ of Higgs Boson and Massless Bosons

This paragraph we will use (48),(49) and (50),(51) to discuss boson particle $\mathbf{Q}(B)$. As an example of υ_e electron neutrino & $\overline{\upsilon}_e$ electron anti-neutrino $\mathrm{F} = \upsilon_e$, $\overline{\mathrm{F}} = \overline{\upsilon}_e$. There are four group modes of color-pair, (65),(66) and (67),(68) for $\mathbf{Q}(B)$ below.

▲▲ color-pair and ▼▼ color-pair

$$▲ \quad \mathbf{Q}(\upsilon_e) = (\ +99.957\ 580\ 882475,\quad +101.957\ 580\ 882475,\quad -201.915\ 161\ 764950\ ) \tag{65.1}$$

$$▲ \quad \mathbf{Q}(\overline{\upsilon}_e) = (\ +101.957\ 580\ 882475,\quad +99.957\ 580\ 882475,\quad -201.915\ 161\ 764950\ ) \tag{65.2}$$

$$▼ \quad \mathbf{Q}(\upsilon_e) = (\ -101.957\ 580\ 882475,\quad -99.957\ 580\ 882475,\quad +201.915\ 161\ 764950\ ) \tag{66.1}$$

$$▼ \quad \mathbf{Q}(\overline{\upsilon}_e) = (\ -99.957\ 580\ 882475,\quad -101.957\ 580\ 882475,\quad +201.915\ 161\ 764950\ ) \tag{66.2}$$

And ▲▼ color-pair and ▼▲ color-pair

$$▲ \quad \mathbf{Q}(\upsilon_e) = (\ +99.957\ 580\ 882475,\quad +101.957\ 580\ 882475,\quad -201.915\ 161\ 764950\ ) \tag{67.1}$$

$$▼ \quad \mathbf{Q}(\overline{\upsilon}_e) = (\ -99.957\ 580\ 882475,\quad -101.957\ 580\ 882475,\quad +201.915\ 161\ 764950\ ) \tag{67.2}$$

$$▼ \quad \mathbf{Q}(\upsilon_e) = (\ -101.957\ 580\ 882475,\quad -99.957\ 580\ 882475,\quad +201.915\ 161\ 764950\ ) \tag{68.1}$$

$$▲ \quad \mathbf{Q}(\overline{\upsilon}_e) = (\ +101.957\ 580\ 882475,\quad +99.957\ 580\ 882475,\quad -201.915\ 161\ 764950\ ) \tag{68.2}$$

- Using

$$\xi = \xi(\upsilon_e) = \xi(\overline{\upsilon}_e) = (\ +100.960\ 057\ 1364450,\quad +100.960\ 057\ 1364450,\quad -201.920\ 114\ 272900\ ) \tag{69}$$

we could obtain neutrino's mass υ_e & $\overline{\upsilon}_e$ below

$$\mathbf{Q}^2(\upsilon_e) = \mathbf{Q}^2(\bar{\upsilon}_e) = 61,156.598\ 825\ 8489 \quad (70)$$

$$\xi^2(\upsilon_e) = \xi^2(\bar{\upsilon}_e) = 61,156.598\ 821\ 8486 \quad (71)$$

$$\mathbf{Q}^2(\upsilon_\mu) - \xi^2(\upsilon_\mu) = \mathbf{Q}^2(\bar{\upsilon}_\mu) - \xi^2(\bar{\upsilon}_\mu) = 0.000\ 004\ 0003 \quad (72.1)$$

$$= \frac{0.000\ 002\ 0442}{0.511} Mev \quad (72.2)$$

- In Complex Number Field $\mathbb{C}(\xi \neq 0)$

$$\blacktriangle \quad \mathbf{Q}(\upsilon_e, \xi) = \mathbf{Q}(\upsilon_e) + i\ \xi(\upsilon_e) = (\ +99.957\ 580\ 882475,\ +101.957\ 580\ 882475,\ -201.915\ 161\ 764950\ ) + i\,\xi \quad (73.1)$$

$$\blacktriangle \quad \mathbf{Q}(\bar{\upsilon}_e, \xi) = \mathbf{Q}(\bar{\upsilon}_e) - i\ \xi(\bar{\upsilon}_e) = (\ +101.957\ 580\ 882475,\ +99.957\ 580\ 882475,\ -201.915\ 161\ 764950\ ) - i\,\xi \quad (73.2)$$

$$\blacktriangledown \quad \mathbf{Q}(\upsilon_e, \xi) = \mathbf{Q}(\upsilon_e) + i\ \xi(\upsilon_e) = (\ -101.957\ 580\ 882475,\ -99.957\ 580\ 882475,\ +201.915\ 161\ 764950\ ) + i\,\xi \quad (74.1)$$

$$\blacktriangledown \quad \mathbf{Q}(\bar{\upsilon}_e, \xi) = \mathbf{Q}(\bar{\upsilon}_e) - i\ \xi(\bar{\upsilon}_e) = (\ -99.957\ 580\ 882475,\ -101.957\ 580\ 882475,\ +201.915\ 161\ 764950\ ) - i\,\xi \quad (74.2)$$

AND

$$\blacktriangle \quad \mathbf{Q}(\upsilon_e, \xi) = \mathbf{Q}(\upsilon_e) + i\ \xi(\upsilon_e) = (\ +99.957\ 580\ 882475,\ +101.957\ 580\ 882475,\ -201.915\ 161\ 764950\ ) + i\,\xi \quad (75.1)$$

$$\blacktriangledown \quad \mathbf{Q}(\bar{\upsilon}_e, \xi) = \mathbf{Q}(\bar{\upsilon}_e) - i\ \xi(\bar{\upsilon}_e) = (\ -99.957\ 580\ 882475,\ -101.957\ 580\ 882475,\ +201.915\ 161\ 764950\ ) - i\,\xi \quad (75.2)$$

$$\blacktriangledown \quad \mathbf{Q}(\upsilon_e, \xi) = \mathbf{Q}(\upsilon_e) + i\ \xi(\upsilon_e) = (\ -101.957\ 580\ 882475,\ -99.957\ 580\ 882475,\ +201.915\ 161\ 764950\ ) + i\,\xi \quad (76.1)$$

$$\blacktriangle \quad \mathbf{Q}(\bar{\upsilon}_e, \xi) = \mathbf{Q}(\bar{\upsilon}_e) - i\ \xi(\bar{\upsilon}_e) = (\ +101.957\ 580\ 882475,\ +99.957\ 580\ 882475,\ -201.915\ 161\ 764950\ ) - i\,\xi \quad (76.2)$$

- With the definition (77), we have two cases of electron neutrino color-pair $\mathbf{Q}(\upsilon_e\bar{\upsilon}_e)$ following

$$\mathbf{Q}(\upsilon_e\bar{\upsilon}_e, \xi) \equiv \mathbf{Q}(\upsilon_e, \xi) + \mathbf{Q}(\bar{\upsilon}_e, \xi) = \mathbf{Q}(\upsilon_e) + \mathbf{Q}(\bar{\upsilon}_e) = \mathbf{Q}(\upsilon_e\bar{\upsilon}_e) \quad (77)$$

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【 Case1 $\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(h, \upsilon_e\overline{\upsilon}_e)$ Higgs 】

- From (73) (74) then obtain

$$\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(\upsilon) + \mathbf{Q}(\overline{\upsilon}) = (+201.915\ 161\ 76490,\ +201.915\ 161\ 76490,\ -403.830\ 323\ 50980) \quad (78.1)$$

$$\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(\upsilon) + \mathbf{Q}(\overline{\upsilon}) = (-201.915\ 161\ 76490,\ -201.915\ 161\ 76490,\ +403.830\ 323\ 50980) \quad (78.2)$$

Ultimately

$$\mathbf{Q}^2(\upsilon_e\overline{\upsilon}_e) = 244,618\ 395\ 303\ 5166 = \frac{125,000.000\ 000\ 0097}{0.511} Mev = M(h, \upsilon_e\overline{\upsilon}_e) \quad (79)$$

【 Case2 $\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(\gamma, \upsilon_e\overline{\upsilon}_e)$ massless bosons: photon, gluon etc. 】

- From (75) (76) then obtain

$$\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(\upsilon) + \mathbf{Q}(\overline{\upsilon}) = (+0,\ +0,\ -0) \quad (80.1)$$

$$\mathbf{Q}(\upsilon_e\overline{\upsilon}_e) = \mathbf{Q}(\upsilon) + \mathbf{Q}(\overline{\upsilon}) = (-0,\ -0,\ +0) \quad (80.2)$$

Ultimately

$$\mathbf{Q}^2(\upsilon_e\overline{\upsilon}_e) = 0 = \frac{0}{0.511} Mev = M(\gamma, \upsilon_e\overline{\upsilon}_e) = M(g, \upsilon_e\overline{\upsilon}_e) \quad (81)$$

With the above example, summary of real part $\mathbf{Q}$ and imaginary ξ of color-pair $\mathbf{Q}(\mathrm{F}, \xi)$ $\mathbf{Q}(\overline{\mathrm{F}}, \xi)$ for bosons are given below

Table 7: Real Part **Q** and Imaginary Part ξ of Color-Pair $\mathbf{Q}(\mathrm{F},\xi), \mathbf{Q}(\overline{\mathrm{F}},\xi)$ for Higgs particle h

A			R	G	B
	$\mathbf{Q}(\upsilon_e)=\mathbf{Q}(\upsilon_\mu)=\mathbf{Q}(\upsilon_\tau)$	=	+99. 957 580 882475	+101. 957 580 882475	–201. 915 161 765000
	$\mathbf{Q}(\overline{\upsilon}_e)=\mathbf{Q}(\overline{\upsilon}_\mu)=\mathbf{Q}(\overline{\upsilon}_\tau)$	=	+101. 957 580 882475	+99. 957 580 882475	–201. 915 161 765000
5	$\xi(\upsilon_\tau) = \xi(\overline{\upsilon}_\tau)$	=	+100. 930 654 7317853	+100. 930 654 7317853	–201. 861 309 4635706
3	$\xi(\upsilon_\mu) = \xi(\overline{\upsilon}_\mu)$	=	+100. 959 750 2356910	+100. 959 750 2356910	–201. 919 500 4713820
1	$\xi(\upsilon_e) = \xi(\overline{\upsilon}_e)$	=	+100. 960 057 1364450	+100. 960 057 1364450	–201. 920 114 2729000
	+202, + 202, − 404				
	$\mathbf{Q}(e^-)=\mathbf{Q}(\mu^-)=\mathbf{Q}(\tau^-)$	=	+99. 957 580 882475	+99. 957 580 882475	–202. 915 161 765000
	$\mathbf{Q}(e^+)=\mathbf{Q}(\mu^+)=\mathbf{Q}(\tau^+)$	=	+101. 957 580 882475	+101. 957 580 882475	–200. 915 161 765000
6	$\xi(\tau^-) = \xi(\tau^+)$	=	+98. 047 695 6369080	+98. 047 695 6369080	–196. 095 391 273816
4	$\xi(\mu^-) = \xi(\mu^+)$	=	+100. 789 177 2553080	+100. 789 177 2553080	–201. 578 354 510616
2	$\xi(e^-) = \xi(e^+)$	=	+100. 959 231 7273405	+100. 959 231 7273405	–201. 918 463 4546810
	$\mathbf{Q}(h, \mathrm{F}\overline{\mathrm{F}})$	=	+201. 915 161 764950	+201. 915 161 764950	–403. 830 323 529900
	$\mathrm{F} = \upsilon_\tau, \upsilon_\mu, \upsilon_e, \tau^-, \mu^-, e^-$				
	$\overline{\mathrm{F}} = \overline{\upsilon}_\tau, \overline{\upsilon}_\mu, \overline{\upsilon}_e, \tau^+, \mu^+, e^+$				

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Part. F: Origins of Mass of M (Z), M (W^-), M (W^+) Vector Bosons and γ Photon by Color-Pair

Following are the sketch of electroweak symmetry particles, which related to Table8, Table9.1 & Table9.2

$$(t, b) \qquad (\upsilon_\tau, \tau)$$

$$(c, s) \qquad (\upsilon_\mu, \mu)$$

$$(u, d) \qquad (\upsilon_e, e)$$

$$\begin{pmatrix} u\bar{u} & u\bar{d} \\ d\bar{u} & d\bar{d} \end{pmatrix} \quad \begin{pmatrix} c\bar{c} & c\bar{s} \\ s\bar{c} & s\bar{s} \end{pmatrix} \quad \begin{pmatrix} t\bar{t} & t\bar{b} \\ b\bar{i} & b\bar{b} \end{pmatrix}$$

$$\begin{pmatrix} \upsilon_e\bar{\upsilon}_e & \upsilon_e e^+ \\ e^-\bar{\upsilon}_e & e^-e^+ \end{pmatrix} \quad \begin{pmatrix} \upsilon_\mu\bar{\upsilon}_\mu & \upsilon_u u^+ \\ u^-\bar{\upsilon}_\mu & \mu^-\mu^+ \end{pmatrix} \quad \begin{pmatrix} \upsilon_\tau\bar{\upsilon}_\tau & \upsilon_\tau\tau^+ \\ \tau^-\bar{\upsilon}_\tau & \tau^-\tau^+ \end{pmatrix} \quad \Rightarrow \quad \begin{pmatrix} Z & W^+ \\ W^- & Z \end{pmatrix}$$

$$\begin{pmatrix} \mathbf{Q}(u\bar{u}, \xi) & \mathbf{Q}(u\bar{d}, \xi) \\ \mathbf{Q}(d\bar{u}) & \mathbf{Q}(d\bar{d}, \xi) \end{pmatrix} \quad \begin{pmatrix} \mathbf{Q}(c\bar{c}, \xi) & \mathbf{Q}(u\bar{d}, \xi) \\ \mathbf{Q}(d\bar{u}) & \mathbf{Q}(d\bar{d}, \xi) \end{pmatrix} \quad \begin{pmatrix} \mathbf{Q}(u\bar{u}, \xi) & \mathbf{Q}(u\bar{d}, \xi) \\ \mathbf{Q}(d\bar{u}) & \mathbf{Q}(d\bar{d}, \xi) \end{pmatrix} \quad \Rightarrow \quad \begin{pmatrix} \mathbf{Q}(Z) & \mathbf{Q}(W^+) \\ \mathbf{Q}(W^-) & \mathbf{Q}(Z) \end{pmatrix} \qquad (82)$$

$$\begin{pmatrix} \mathbf{Q}(\upsilon_e\bar{\upsilon}_e, \xi) & \mathbf{Q}(\upsilon_e e^+, \xi) \\ \mathbf{Q}(e^-\bar{\upsilon}_e, \xi) & \mathbf{Q}(e^-e^+, \xi) \end{pmatrix} \quad \begin{pmatrix} \mathbf{Q}(\upsilon_\mu\bar{\upsilon}_\mu, \xi) & \mathbf{Q}(\upsilon_u u^+, \xi) \\ \mathbf{Q}(u^-\bar{\upsilon}_\mu, \xi) & \mathbf{Q}(\mu^-\mu^+, \xi) \end{pmatrix} \quad \begin{pmatrix} \mathbf{Q}(\upsilon_\tau\bar{\upsilon}_\tau, \xi) & \mathbf{Q}(\upsilon_\tau\tau^+, \xi) \\ \mathbf{Q}(\tau^-\bar{\upsilon}_\tau, \xi) & \mathbf{Q}(\tau^-\tau^+, \xi) \end{pmatrix} \quad \Rightarrow \quad \begin{pmatrix} \mathbf{Q}(Z) & \mathbf{Q}(W^+) \\ \mathbf{Q}(W^-) & \mathbf{Q}(Z) \end{pmatrix} \qquad (83)$$

$$\Rightarrow \quad \begin{pmatrix} \mathbf{Q}(h) & \\ & \mathbf{Q}(h) \end{pmatrix} \qquad (84)$$

Table 8: Real Part **Q** and Imaginary Part ξ of Color-Pair $\mathbf{Q}(\mathrm{F},\xi), \mathbf{Q}(\overline{\mathrm{F}},\xi)$ for Vector Boson particle Z

B			R	G	B
	$\mathbf{Q}(\upsilon_e)=\mathbf{Q}(\upsilon_\mu)=\mathbf{Q}(\upsilon_\tau)$	=	+85. 234 559 29745	+87. 234 559 29745	−172. 469 118 59490
	$\mathbf{Q}(\overline{\upsilon}_e)=\mathbf{Q}(\overline{\upsilon}_\mu)=\mathbf{Q}(\overline{\upsilon}_\tau)$	=	+87. 234 559 29745	+85. 234 559 29745	−172. 469 118 59490
11	$\xi(\upsilon_\tau) = \xi(\overline{\upsilon}_\tau)$	=	+86. 202 067 666615	+86. 202 067 666615	−172. 404 135 333230
9	$\xi(\upsilon_\mu) = \xi(\overline{\upsilon}_\mu)$	=	+86. 236 132 685580	+86. 236 132 685580	−172. 472 265 371160
7	$\xi(\upsilon_e) = \xi(\overline{\upsilon}_e)$	=	+86. 236 491 985160	+86. 236 491 985160	−172. 472 983 970320
	$\mathbf{Q}(e^-)=\mathbf{Q}(\mu^-)=\mathbf{Q}(\tau^-)$	=	+85. 234 559 29745	+85. 234 559 29745	−173. 469 118 59490
	$\mathbf{Q}(e^+)=\mathbf{Q}(\mu^+)=\mathbf{Q}(\tau^+)$	=	+87. 234 559 29745	+87. 234 559 29745	−171. 469 118 59490
12	$\xi(\tau^-) = \xi(\tau^+)$	=	+82. 807 910 447131	+82. 807 910 447131	−165. 615 820 894262
10	$\xi(\mu^-) = \xi(\mu^+)$	=	+86. 036 374 079308	+86. 036 374 079308	−172. 072 748 158616
8	$\xi(e^-) = \xi(e^+)$	=	+86. 236 491 988942	+86. 236 491 988942	−172. 472 983 977884
	$\mathbf{Q}(Z, \mathrm{F}\overline{\mathrm{F}})$	=	+172. 469 118 59490	+172. 469 118 59490	−344. 938 237 18980
	$\mathrm{F} = \upsilon_\tau, \upsilon_\mu, \upsilon_e, \tau^-, \mu^-, e^-$				
	$\overline{\mathrm{F}} = \overline{\upsilon}_\tau, \overline{\upsilon}_\mu, \overline{\upsilon}_e, \tau^+, \mu^+, e^+$				

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Table 9.1: Real Part **Q** and Imaginary Part ξ of Color-Pair $\mathbf{Q}(\mathrm{F},\xi)$, $\mathbf{Q}(\overline{\mathrm{F}},\xi)$ for Vector Boson particle W^-

C1			R	G	B
▲	$\mathbf{Q}(e^-)=\mathbf{Q}(\mu^-)=\mathbf{Q}(\tau^-)$	=	+79. 966 441 56979	+79. 966 441 56979	–162. 932 883 13958
▲	$\mathbf{Q}(\overline{\upsilon}_e)=\mathbf{Q}(\overline{\upsilon}_\mu)=\mathbf{Q}(\overline{\upsilon}_\tau)$	=	+81. 966 441 57381	+79. 966 441 57381	–161. 932 883 14762
	$\mathbf{Q}(W^-,\mathrm{F}\overline{\mathrm{F}})$	=	+161. 932 883 14360	+159. 932 883 14360	–324. 865 766 28720
	$\mathrm{F}=\ \tau^-,\mu^-,e^-;\ \overline{\mathrm{F}}=\ \overline{\upsilon}_\tau,\overline{\upsilon}_\mu,\overline{\upsilon}_e$				
$\triangle^-$			+161	+161	–325
17	$\xi(\tau^-)\ =\ \xi(\overline{\upsilon}_\tau)$	=	+79. 160 327 98749	+79. 160 327 98749	–158. 320 655 97498
15	$\xi(\mu^-)\ =\ \xi(\overline{\upsilon}_\mu)$	=	+80. 862 377 41337	+80. 862 377 41337	–161. 724 754 82674
13	$\xi(e^-)\ =\ \xi(\overline{\upsilon}_e)$	=	+80. 968 500 00960	+80. 968 500 00960	–161. 937 000 01920
▼	$\mathbf{Q}(e^-)=\mathbf{Q}(\mu^-)=\mathbf{Q}(\tau^-)$	=	–81. 966 441 56979	–81. 966 441 56979	+160. 932 883 13958
▼	$\mathbf{Q}(\overline{\upsilon}_e)=\mathbf{Q}(\overline{\upsilon}_\mu)=\mathbf{Q}(\overline{\upsilon}_\tau)$	=	–79. 966 441 57381	–81. 966 441 57381	+161. 932 883 14762
	$\mathbf{Q}(W^-,\mathrm{F}\overline{\mathrm{F}})$	=	–161. 932 883 14360	–163. 932 883 14360	+322. 865 766 28720
	$\mathrm{F}=\ \tau^-,\mu^-,e^-;\ \overline{\mathrm{F}}=\ \overline{\upsilon}_\tau,\overline{\upsilon}_\mu,\overline{\upsilon}_e$				
∇^-			–163	–163	+323
18	$\xi(\upsilon_\tau)\ =\ \xi(\tau^+)$	=	–79. 160 327 98749	–79. 160 327 98749	+158. 320 655 97498
16	$\xi(\upsilon_\mu)\ =\ \xi(\mu^+)$	=	–80. 862 377 41337	–80. 862 377 41337	+161. 724 754 82674
14	$\xi(\upsilon_e)\ =\ \xi(e^+)$	=	–80. 968 500 00960	–80. 968 500 00960	+161. 937 000 01920

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Table 9.2: Real Part **Q** and Imaginary Part ξ of Color-Pair $\mathbf{Q}(\mathrm{F},\xi)$, $\mathbf{Q}(\overline{\mathrm{F}},\xi)$ for Vector Boson particle W^{+}

C2			R	G	B
▲	$\mathbf{Q}(e^{+})=\mathbf{Q}(\mu^{+})=\mathbf{Q}(\tau^{+})$	=	+81. 966 441 56979	+81. 966 441 56979	−160. 932 883 13958
▲	$\mathbf{Q}(\upsilon_{e})=\mathbf{Q}(\upsilon_{\mu})=\mathbf{Q}(\upsilon_{\tau})$	=	+79. 966 441 57381	+81. 966 441 57381	−161. 932 883 14762
▲	$\mathbf{Q}(W^{+},\mathrm{F}\overline{\mathrm{F}})$	=	+161. 932 883 14360	+163. 932 883 14360	−322. 865 766 28720
	$\mathrm{F}=\upsilon_{\tau},\upsilon_{\mu},\upsilon_{e};\ \overline{\mathrm{F}}=\tau^{+},\mu^{+},e^{+}$				
$\triangle^{+}$			+163	+163	−323
17	$\xi(\tau^{+})=\xi(\upsilon_{\tau})$	=	+79. 160 327 98749	+79. 160 327 98749	−158. 320 655 97498
15	$\xi(\mu^{+})=\xi(\upsilon_{\mu})$	=	+80. 862 377 41337	+80. 862 377 41337	−161. 724 754 82674
13	$\xi(e^{+})=\xi(\upsilon_{e})$	=	+80. 968 500 00960	+80. 968 500 00960	−161. 937 000 01920
▼	$\mathbf{Q}(e^{+})=\mathbf{Q}(\mu^{+})=\mathbf{Q}(\tau^{+})$	=	−79. 966 441 56979	−79. 966 441 56979	+162. 932 883 13958
▼	$\mathbf{Q}(\upsilon_{e})=\mathbf{Q}(\upsilon_{\mu})=\mathbf{Q}(\upsilon_{\tau})$	=	−81. 966 441 57381	−79. 966 441 57381	+161. 932 883 14762
▼	$\mathbf{Q}(W^{+},\mathrm{F}\overline{\mathrm{F}})$	=	−161. 932 883 14360	−159. 932 883 14360	+324. 865 766 28720
	$\mathrm{F}=\upsilon_{\tau},\upsilon_{\mu},\upsilon_{e};\ \overline{\mathrm{F}}=\tau^{+},\mu^{+},e^{+}$				
∇^{+}		=	−161	−161	+325
18	$\xi(\tau^{+})=\xi(\upsilon_{\tau})$	=	+79. 160 327 98749	+79. 160 327 98749	−158. 320 655 97498
16	$\xi(\mu^{+})=\xi(\upsilon_{\mu})$	=	+80. 862 377 41337	+80. 862 377 41337	−161. 724 754 82674
14	$\xi(e^{+})=\xi(\upsilon_{e})$	=	+80. 968 500 00960	+80. 968 500 00960	−161. 937 000 01920

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Part. G: Asymmetrical Phenomena of Isospin and Hypercharge of Bosons

Now we continue to discuss paragraph **9**, firstly we look at following two boson isospin tables (Table10.1, Table10.2) with different array of their color representation $B_{\mathrm{RGB}}=(B_{\mathrm{R}}, B_{\mathrm{G}}, B_{\mathrm{B}})$ $(B \equiv Boson)$

Table 10.1: Symmetrical Color (SC) Representation B_{RGB} of Boson Isospin

X^{++}	W^{+}	$Z,\ h$	W^{-}	X^{--}
$I_3(X^{+})\ +2$	$I_3(W^{+})\ +1$	$I_3(Z)\ 0$	$I_3(W^{-})\ -1$	$I_3(X^{-})\ -2$
$X_{\mathrm{R}}^{++}\ X_{\mathrm{G}}^{++}\ X_{\mathrm{B}}^{++}$	$W_{\mathrm{R}}^{+}\ W_{\mathrm{G}}^{+}\ W_{\mathrm{B}}^{+}$	$Z_{\mathrm{R}}\ Z_{\mathrm{G}}\ Z_{\mathrm{B}}$	$W_{\mathrm{R}}^{-}\ W_{\mathrm{G}}^{-}\ W_{\mathrm{B}}^{-}$	$X_{\mathrm{R}}^{--}\ X_{\mathrm{G}}^{--}\ X_{\mathrm{B}}^{--}$
$+3\ \ +2\ \ +1$	$+2\ \ +1\ \ 0$	$+1\ \ 0\ \ -1$	$0\ \ -1\ \ -2$	$-1\ \ -2\ \ -3$
$(+3, +2, +1)$	$(+2, +1, 0)$	$(+1, 0, -1)$	$(0, -1, -2)$	$(-1, -2, -3)$

Table 10.2: Asymmetrical Color (ASC) Representation B_{RGB} of Boson Isospin

X^{++}	W^{+}	$Z,\ h$	W^{-}	X^{--}
$I_3(X^{+})\ \frac{+5}{2}$	$I_3(W^{+})\ \frac{+1}{2}$	$I_3(Z),\ I_3(h)\ \frac{-1}{2}$	$I_3(W^{-})\ \frac{-3}{2}$	$I_3(X^{-})\ \frac{-5}{2}$
$X_{\mathrm{R}}^{++}\ X_{\mathrm{G}}^{++}\ X_{\mathrm{B}}^{++}$	$W_{\mathrm{R}}^{+}\ W_{\mathrm{G}}^{+}\ W_{\mathrm{B}}^{+}$	$Z_{\mathrm{R}}\ Z_{\mathrm{G}}\ Z_{\mathrm{B}}$	$W_{\mathrm{R}}^{-}\ W_{\mathrm{G}}^{-}\ W_{\mathrm{B}}^{-}$	$X_{\mathrm{R}}^{--}\ X_{\mathrm{G}}^{--}\ X_{\mathrm{B}}^{--}$
$\frac{+7}{4}\ \ +2\ \ \frac{+5}{4}$	$\frac{+1}{4}\ \ +1\ \ \frac{+1}{4}$	$\frac{-3}{4}\ \ 0\ \ \frac{-3}{4}$	$\frac{-7}{4}\ \ -1\ \ \frac{-7}{4}$	$\frac{-1}{4}\ \ -2\ \ \frac{-11}{4}$
$(\frac{+7}{4}, +2, \frac{+5}{4})$	$(\frac{+1}{4}, +1, \frac{+1}{4})$	$(\frac{-3}{4}, 0, \frac{-3}{4})$	$(\frac{-7}{4}, -1, \frac{-7}{4})$	$(\frac{-1}{4}, -2, \frac{-11}{4})$

From Table10.1, yielding

Table 11.1: Values of $\mathbf{Q}(B)$, $\mathbf{I}_3(B)$, $\mathbf{Y}(B)$ in Gell-mann-Nishijima Relation for Symmetrical Color Array B_{RGB}(SC)

B	I			$\mathbf{Q}(B,\xi)$	$Q(B)$		$\mathbf{I}_3(B)$	$I_3(B)$		$\frac{1}{2}\mathbf{Y}(B,\xi)$	$Y(B)$
▲											
W^+	1	$\triangle^+$	‖	(+163, +163, −323)	+1	‖	(+2, +1, 0)	+1	‖	(+161, +162, −323)	0
Z	1		‖	(+172. 47, +172. 47, −344. 94)	0	‖	(+1, 0, −1)	0	‖	(+171. 47, +172. 47, −343. 94)	0
W^-	1	$\triangle^-$		(+161, +161, −325)	−1	‖	(0, −1, −2)	−1	‖	(+161, +162, −323)	0
h	0		‖	(+202, +202, −404)	0	‖	(+1, 0, −1)	0	‖	(+201, +202, −403)	0
—	—		‖	————————	—	‖	———	—	‖	————————	—
▼											
W^+	1	∇^+	‖	(−161, −161, +325)	+1	‖	(+2, +1, 0)	+1	‖	(−163, −162, +325)	0
Z	1		‖	(−172. 47, −172. 47, +344. 94)	0	‖	(+1, 0, −1)	0	‖	(−173. 47, −172. 47, +345. 94)	0
W^-	1	∇^-		(−163, −163, +323)	−1	‖	(0, −1, −2)	−1	‖	(−163, −162, +325)	0
			‖								
h	0			(−202, −202, +404)	0	‖	(+1, 0, −1)	0	‖	(−203, −202, +405)	0

Compare the values of I_3 & Y between Table 11.1 and Table 11.2

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From Table10.2, yielding

Table 11.2: Values of $\mathbf{Q}(B)$, $\mathbf{I}_3(B)$, $\mathbf{Y}(B)$ in Gell-mann-Nishijima Relation for Asymmetrical Color Array B_{RGB}(ASCA)

B	I			$\mathbf{Q}(B,\xi)$	$Q(B)$		$\mathbf{I}_3(B)$	$I_3(B)$		$\frac{1}{2}\mathbf{Y}(B,\xi)$	$Y(B)$
▲											
W^+	1	$\triangle^+$	||	$(+163,\ +163,\ -323)$	$+1$	||	$(\frac{+1}{4},\ +1,\ \frac{+1}{4})$	$+\frac{1}{2}$	||	$(+162.75,\ +162,\ -323.25)$	$+1$
Z	1		||	$(+172.47,\ +172.47,\ -344.94)$	0	||	$(\frac{-3}{4},\ 0,\ \frac{-3}{4})$	$-\frac{1}{2}$	||	$(+173.22,\ +172.47,\ -344.19)$	$+1$
W^-	1	$\triangle^-$		$(+161,\ +161,\ -325)$	-1	||	$(\frac{-7}{4},\ -1,\ \frac{-7}{4})$	$-\frac{3}{2}$	||	$(+162.75,\ +162,\ -323.25)$	$+1$
h	0		||	$(+202,\ +202,\ -404)$	0	||	$(\frac{-3}{4},\ 0,\ \frac{-3}{4})$	$-\frac{1}{2}$	||	$(+202.75,\ +202,\ -403.25)$	$+1$
—	—		||	————————	—	||	———	—	||	————————	—
▼											
W^+	1	$\bigtriangledown^+$	||	$(-161,\ -161,\ +325)$	$+1$	||	$(\frac{+1}{4},\ +1,\ \frac{+1}{4})$	$+\frac{1}{2}$	||	$(-161.25,\ -162,\ +324.75)$	$+1$
Z	1		||	$(-172.47,\ -172.47,\ +344.94)$	0	||	$(\frac{-3}{4},\ 0,\ \frac{-3}{4})$	$-\frac{1}{2}$	||	$(-171.22,\ -172.47,\ +346.69)$	$+1$
W^-	1	$\bigtriangledown^-$		$(-163,\ -163,\ +323)$	-1	||	$(\frac{-7}{4},\ -1,\ \frac{-7}{4})$	$-\frac{3}{2}$	||	$(-161.25,\ -162,\ +324.75)$	$+1$
			||								
h	0			$(-202,\ -202,\ +404)$	0	||	$(\frac{-3}{4},\ 0,\ \frac{-3}{4})$	$-\frac{1}{2}$	||	$(-201.25,\ -202,\ +404.75)$	$+1$

Compare the values of I_3 & Y between Table11.2 and Table11.1

Conclusions and Outlook

Here, some small but guided understanding the purpose for the readers of this paper following

- In current Gell-mann-Nishijima Relation, quantum numbers Q electrical charge, I_3 isospin and Y hypercharge are C *numbers*, common numbers. After Colorization of this relation, these three quantum numbers become opeartors **Q**, $\mathbf{I}_3$ and **Y**, each of them is extended to three dimensional colore space (R, G, B). Increaser the new degrees of freedom, clearer the physical system.

- By Mass Principle, the ground states of elecmentary fermion spectrum is scheduled, expecially neutrinos masses with more details described in paragraph **7.** When the elecmentary fermions are excited, **Q** is depicted by complex color $\mathbf{Q} + i\xi$.

The results of disscussions for Higgs boson and for massless bosons in paragraph **10** also are the same for vector neutral boson Z and massless boson.

- From Table10,2 (Asymmetrical Color (ASC) Representation B_{RGB} of Boson Isospin), may be the possibility of X^{++} and X^{--} bosons.

$$Q(X^{++}) = I_3(X^{++}) + \tfrac{1}{2}Y(X^{++}) = +\tfrac{3}{2} + \tfrac{1}{2}(+1) = +2$$

$$Q(W^{+}) = I_3(W^{+}) + \tfrac{1}{2}Y(W^{+}) = +\tfrac{1}{2} + \tfrac{1}{2}(+1) = +1$$

$$Q(Z, h) = I_3(Z, h) + \tfrac{1}{2}Y(Z, h) = -\tfrac{1}{2} + \tfrac{1}{2}(+1) = 0$$

$$Q(W^{-}) = I_3(W^{-}) + \tfrac{1}{2}Y(W^{-}) = -\tfrac{3}{2} + \tfrac{1}{2}(+1) = -1$$

$$Q(X^{--}) = I_3(X^{--}) + \tfrac{1}{2}Y(X^{--}) = -\tfrac{5}{2} + \tfrac{1}{2}(+1) = -2$$

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- From Table11.2 (Values of $\mathbf{Q}(B)$, $\mathbf{I}_3(B)$, $\mathbf{Y}(B)$ in Gell-mann-Nishijima Relation for Asymmetrical Color Array B_{RGB}(ASCA)), may be the possibility of X boson composed of W^+ and W^-, whose mass is about $322\ Gev$.

$$\triangle^+ \qquad \mathbf{Q}(W^+,\xi) = (\ +163,\quad +163,\quad -323\ )\ +\ i\xi$$

$$\triangle^- \qquad \mathbf{Q}(W^-,\xi) = (\ +161,\quad +161,\quad -325\ )\ -\ i\xi$$

$$\mathbf{Q}(W^+W^-,\xi) = \mathbf{Q}(W^+,\xi) + \mathbf{Q}(W^-,\xi) = \mathbf{Q}(W^+) + \mathbf{Q}(W^-) = \mathbf{Q}(W^+W^-) = (\ +324,\quad +324,\quad -646\ )$$

$$\mathbf{Q}^2(\ X(W^+W^-),\xi) = \mathbf{Q}^2(W^+W^-) = 629,856 = 321,856.416\ Mev \approx 322\ Gev$$

- Neutrino Scalar Product Matrix $\mathbf{Q}^2(\upsilon_i\upsilon_j) = \mathbf{Q}(\upsilon_i)\cdot\mathbf{Q}(\upsilon_j)$

$$\mathbf{Q}^2(\upsilon_i\upsilon_j) = \begin{pmatrix} \mathbf{Q}(\upsilon_e)\mathbf{Q}(\upsilon_e) & \mathbf{Q}(\upsilon_e)\mathbf{Q}(\upsilon_\mu) & \mathbf{Q}(\upsilon_e)\mathbf{Q}(\upsilon_\tau) \\ \mathbf{Q}(\upsilon_\mu)\mathbf{Q}(\upsilon_e) & \mathbf{Q}(\upsilon_\mu)\mathbf{Q}(\upsilon_\mu) & \mathbf{Q}(\upsilon_\mu)\mathbf{Q}(\upsilon_\tau) \\ \mathbf{Q}(\upsilon_\tau)\mathbf{Q}(\upsilon_e) & \mathbf{Q}(\upsilon_\tau)\mathbf{Q}(\upsilon_e) & \mathbf{Q}(\upsilon_\tau)\mathbf{Q}(\upsilon_\tau) \end{pmatrix} = \begin{pmatrix} 0.000\ 003\ 9138 & 0.000\ 201\ 0565 & 0.001\ 967\ 7821 \\ 0.000\ 201\ 0565 & 0.371\ 819\ 9609 & 3.639\ 079\ 9266 \\ 0.001\ 967\ 7821 & 3.639\ 079\ 9266 & 35.616\ 438\ 3571 \end{pmatrix}$$

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