Calculation of the elementary particle mass

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Abstract

In this paper, the mass derived from the g_equation [1] is assumed to be the mass of quark-lepton, and is used to calculate the masses of the most common elementary particles. The difference between the calculated results and observed values [2] is within 3% [3].

この論文では、g_equation から導出した質量を quark-lepton の質量と仮定し、主な素粒子の質量を計算する。計算結果と観測値との差は 3%以内である。

1 "質量式"

1.1 誘電率と質量

ある条件下の g_equation は、相互作用項を含む非線形微分方程式となる。相互作項がゼロになる時空を選ぶことにより距離の逆二乗の相互作用式とソリトン解が得られる。ソリトン解と相互作用式から質量の次元を持つ"質量式"が得られる。

$$M = \frac{1}{\sqrt{\epsilon_0^{1/2}}} \sqrt{\frac{\pi\hbar}{2c^2\tau}} \sqrt{\frac{q^2}{4\pi G}}$$

c : velocity of light	$\hbar$: Planck's constant
G : gravitation constant	q : electric charge
τ : Age of the Universe	ϵ_0 : permittivity

[1] pending/3016590 rejected , 30 Sep 2005 14:01:55 , www-admin@arxiv.org

[2] Particle Data Group (PDG) "Particle Physics Booklet July 2010"

[3] | (observed value) − (calculation result) | /(observed value)

宇宙の膨張とともに ϵ が遷移して質量 $M_{(n\ ,\ \gamma_q)}$ が生成されたと仮定する。この時、ϵ_{n-2} は数値のみが遷移するとし、次元は常に $\epsilon^{1/2}$ の次元であることに注意する必要がある。

$$M_{(n\ ,\ \gamma_q)} \equiv \frac{1}{\sqrt{\epsilon_{n-2}}}\sqrt{\frac{\pi\hbar}{2c^2\tau}}\sqrt{\frac{q^2}{4\pi G}} \qquad \epsilon_{n-2} \equiv \frac{\left(\gamma_q \epsilon_0^{1/2}\right)^n}{n-1}$$

$$\gamma_q = 1/3\ ,\ \ 2/3\ ,\ \ 3/3$$
$$n = 2\ ,\ \ 3\ ,\ \ 4\ ,\ \ \cdots$$

1.2 電子質量と宇宙年齢

$M_{(n\ ,\ \gamma_q)}$ に物理定数を代入すると $M_{(4\ ,\ 3/3)}$ が電子質量に最も近い値を示す。このため $M_{(4\ ,\ 3/3)}$ を電子質量と定義して表 1 を得る。

τ を再計算すると現在の観測値より 12 億年程度古い値となるが、それは ϵ_0 として定義された値によって変わる。

$$\tau_U = 4.702226 * 10^{+17}\ [s] \qquad \text{mass of electron}:\ M_{(4\ ,\ 3/3)} = 9.109382 * 10^{-31}\ [kg]$$

表 1: $M_{(n\ ,\ \gamma_q)}\ [kg]$

$n \diagdown \gamma_q$	1/3	2/3	3/3
2	$4.898169 * 10^{-36}$	$2.449084 * 10^{-36}$	$1.632723 * 10^{-36}$
3	$6.955401 * 10^{-33}$	$2.459105 * 10^{-33}$	$1.338567 * 10^{-33}$
4	$8.553449 * 10^{-30}$	$2.138362 * 10^{-30}$	$9.503833 * 10^{-31}$
5	$9.917086 * 10^{-27}$	$1.753109 * 10^{-27}$	$6.361814 * 10^{-28}$
6	$1.113300 * 10^{-23}$	$1.391626 * 10^{-24}$	$4.123336 * 10^{-25}$

2 定義

2.1 quark-lepton の定義

quark-lepton を下記の様に表記及び定義し、u_n , d_n を quark、g_n , z_n を lepton と呼ぶことにする。

$$z_n\ :\quad Mass(z_n) \equiv M_{(n\ ,\ 0/3)}\ ,\quad Spin(z_n) \equiv -\frac{1}{2}\ ,\quad Charge(z_n) \equiv +\frac{0}{3}$$

$$d_n\ :\quad Mass(d_n) \equiv M_{(n\ ,\ 1/3)}\ ,\quad Spin(d_n) \equiv +\frac{1}{2}\ ,\quad Charge(d_n) \equiv +\frac{1}{3}$$

$$u_n\ :\quad Mass(u_n) \equiv M_{(n\ ,\ 2/3)}\ ,\quad Spin(u_n) \equiv +\frac{1}{2}\ ,\quad Charge(u_n) \equiv +\frac{2}{3}$$

$$g_n\ :\quad Mass(g_n) \equiv M_{(n\ ,\ 3/3)}\ ,\quad Spin(g_n) \equiv +\frac{1}{2}\ ,\quad Charge(g_n) \equiv -\frac{3}{3}$$

2.2 符号反転記号の定義

任意の quark-lepton を x , y とし、符号を反転する記号 x^M , x^S , x^C , $-x$ を定義する。

$$Mass(x^M) = -Mass(x) \ , \qquad (x+y)^M = x^M + y^M \ , \quad (x^M)^M = x$$
$$Spin(x^S) = -Spin(x) \ , \qquad (x+y)^S = x^S + y^S \ , \quad (x^C)^C = x$$
$$Charge(x^C) = -Charge(x) \ , \quad (x+y)^C = x^C + y^C \ , \quad (x^S)^S = x$$

$$x^{MSC} = -x$$
$$-(-x) = (x^{MSC})^{MSC} = x$$
$$x - x = x + x^{MSC} = 0$$

$$(-x)^M = (x^{MSC})^M = x^{SC} = -x^M$$
$$(-x)^S = (x^{MSC})^S = x^{MC} = -x^S \equiv x^A$$
$$(-x)^C = (x^{MSC})^C = x^{MS} = -x^C$$

2.3 quark-lepton と符号反転記号

$$z_n^C = z_n$$
$$z_n^{MS} = -z_n^C = -z_n$$
$$-z_n^A = (z_n^{MSC})^{MC} = z_n^S$$
$$-d_n^A = (d_n^{MSC})^{MC} = d_n^S$$
$$-u_n^A = (u_n^{MSC})^{MC} = u_n^S$$
$$-g_n^A = (g_n^{MSC})^{MC} = g_n^S$$

2.4 photon の定義

γ、$\mathcal{E}$、$\mathcal{G}$ には必要に応じて添字を付ける。

$$\mathcal{E}_{z_n} = z_n + z_n^S$$
$$Mass(\mathcal{E}) = Mass(z_n + z_n^S)$$
$$Spin(\mathcal{E}) = Spin(z_n + z_n^S) = 0$$
$$Charge(\mathcal{E}) = Charge(z_n + z_n^S) = 0$$

$$\gamma_n^A = \gamma_n^{MC} = \gamma_n$$
$$\gamma_n \ = \ u_n + d_n + g_n + z_n$$
$$Mass(\gamma_n) = Mass(u_n + d_n + g_n + z_n) = 0$$
$$Spin(\gamma_n) = Spin(u_n + d_n + g_n + z_n) = +1$$
$$Charge(\gamma_n) = Charge(u_n + d_n + g_n + z_n) = 0$$

$$\mathcal{G}_n^A = \mathcal{G}_n^{MC} = \mathcal{G}_n$$
$$\mathcal{G}_n = u_n + d_n + g_n + z_n^S$$
$$Mass(\mathcal{G}_n) = Mass(u_n + d_n + g_n + z_n^S) = 0$$
$$Spin(\mathcal{G}_n) = Spin(u_n + d_n + g_n + z_n^S) = +2$$
$$Charge(\mathcal{G}_n) = Charge(u_n + d_n + g_n + z_n^S) = 0$$

2.5 antiquark-antilepton の定義

$$\gamma_{z_n} = (z_n + z_n^{MC})^S = (z_n + z_n^A)^S = -z_n + z_n^S$$
$$\gamma_{d_n} = d_n + d_n^{MC} = d_n + d_n^A = d_n - d_n^S$$
$$\gamma_{u_n} = u_n + u_n^{MC} = u_n + u_n^A = u_n - u_n^S$$
$$\gamma_{g_n} = g_n + g_n^{MC} = g_n + g_n^A = g_n - g_n^S$$

2.6 変換式の定義

$$-z_n \qquad \rightarrow (z_{n-1} + z_{n-1}^S) + \cdots + (z_3 + z_3^S) + z_2 + \gamma_w$$
$$d_n + u_n \rightarrow \gamma_{(d_n+u_n)} - (g_n + z_n)$$

2.7 quark-lepton 質量の定義

電子質量から定義した宇宙年齢を用いて再計算した $M_{(n\ ,\ \gamma_Q)}$ を、quark-lepton の質量と定義する。

表 2: quark-lepton mass $[kg]$

n	z_n	d_n	u_n	g_n
2	$-8.607268 * 10^{-36}$	$4.694873 * 10^{-36}$	$2.347436 * 10^{-36}$	$1.564957 * 10^{-36}$
3	$-1.030677 * 10^{-32}$	$6.666722 * 10^{-33}$	$2.357042 * 10^{-33}$	$1.283011 * 10^{-33}$
4	$-1.115899 * 10^{-29}$	$8.198443 * 10^{-30}$	$2.049610 * 10^{-30}$	$9.109382 * 10^{-31}$
5	$-1.179560 * 10^{-26}$	$9.505484 * 10^{-27}$	$1.680348 * 10^{-27}$	$6.097770 * 10^{-28}$
6	$-1.240002 * 10^{-23}$	$1.067094 * 10^{-23}$	$1.333867 * 10^{-24}$	$3.952200 * 10^{-25}$

表 3: quark-lepton mass $[MeV]$

n	z_n	d_n	u_n	g_n
2	$-4.828323 * 10^{-6}$	$2.633631 * 10^{-6}$	$1.316815 * 10^{-6}$	$8.778770 * 10^{-7}$
3	$-5.781677 * 10^{-3}$	$3.739757 * 10^{-3}$	$1.322203 * 10^{-3}$	$7.197166 * 10^{-4}$
4	$-6.259736 * 10^{+0}$	$4.598990 * 10^{+0}$	$1.149747 * 10^{+0}$	$5.109989 * 10^{-1}$
5	$-6.616852 * 10^{+3}$	$5.332186 * 10^{+3}$	$9.426062 * 10^{+2}$	$3.420598 * 10^{+2}$
6	$-6.955906 * 10^{+6}$	$5.985959 * 10^{+6}$	$7.482448 * 10^{+5}$	$2.217021 * 10^{+5}$

3 素粒子

3.1 素粒子と反素粒子

quark-lepton で構成される素粒子 (elementary particle) と反素粒子 (anti elementary particle) をそれぞれ $(e.p.)$ 及び $(e.p.)^A$ とする。

$$\gamma_{(e.p.)} = (e.p.) + (e.p.)^A$$

3.2 素粒子の構成式

$$(e.p.) = \sum_n (N_{u_n} u_n + N_{d_n} d_n + N_{g_n} g_n + N_{z_n} z_n + N_{z_n^S} z_n^S)$$

3.3 素粒子の質量式

$$Mass(e.p.) = M_q(1 - N_q b_q) + M_l(1 - N_l b_l)$$

$$\cdot M_q = \frac{1}{N_q}(\sum_i c_{u_i} N_{u_i} u_i + \sum_j c_{d_j} N_{d_j} d_j)$$

$$\cdot\, M_l = \sum_i \frac{1}{n_{g_i}} c_{g_i} N_{g_i} g_i + \sum_j \frac{1}{n_{z_j}} c_{z_j} N_{z_j} z_j + \sum_k \frac{1}{n_{z_k^S}} c_{z_k} N_{z_k^S} z_k^S$$

$$\cdot\, N_q = \sum_i N_{u_i} + \sum_j N_{d_j}$$

$$\cdot\, N_l = \sum_i N_{g_i} + \sum_j N_{z_j} + \sum_k N_{z_k^S}$$

$$\cdot\, b_q = \frac{4\pi}{r_s^2} \left(\sum_i (N_{u_i} u_i)^2 + \sum_j (N_{d_j} d_j)^2 \right)$$

$$\cdot\, b_l = \frac{4\pi}{r_s^2} \left(\sum_i (N_{g_i} g_i)^2 + \sum_j \left((N_{z_j} + N_{z_j^S}) z_j \right)^2 \right)$$

$$\cdot\, r_s = \sum_i N_{u_i} u_i + \sum_j N_{d_j} d_j + \sum_k N_{g_k} g_k + \sum_n (N_{z_n} + N_{z_n^S}) z_n$$

結合率 b_q , b_l は r_s で規格化された半径がつくる球の表面積の総和であると定義する。r_s は quark-lepton の和であることに注意が必要である。
N_{x_n} , $N_{z_n^S}$, n_{x_n} , $n_{z_n^S}$ $(x \equiv z\,,\, d\,,\, u\,,\, g)$ は quark-lepton の個数である。
c_{x_n} $(x \equiv z\,,\, d\,,\, u\,,\, g)$ は quark-lepton のクラスで表 4 に定義する。

表 4: Class-Table

n	c_{zn}	c_{dn}	c_{un}	c_{gn}
2	5	3	3	3
3	4	3	3	4
4	3	3	3	5
5	2	3	3	6
6	1	3	3	7

3.4 記号の対応付け

$$\begin{array}{lllllll} u_4 & \to & u & , & u_4^A & \to & \overline{u} \\ d_4 & \to & \overline{d} & , & d_4^A & \to & d \\ g_4 & \to & e^- & , & g_4^A & \to & e^+ \\ z_4 & \to & \nu_\tau & , & z_4^A & \to & \overline{\nu_\tau} \\ z_3 & \to & \nu_\mu & , & z_3^A & \to & \overline{\nu_\mu} \\ z_2 & \to & \overline{\nu_e} & , & z_2^A & \to & \nu_e \end{array}$$

4 素粒子質量の計算

4.1 proton

4.1.1 proton p^+

$$p^+ = u_5 + u_4 - d_4 = u_5 + u_4 + d_4^{AS}$$

$$Spin(p^+) = +\frac{1}{2} + \frac{1}{2} - \frac{1}{2} = +\frac{1}{2}$$

$$Charge(p^+) = +\frac{2}{3} + \frac{2}{3} - \frac{1}{3} = +1$$

$$\begin{aligned} Mass(p^+) &= \frac{1}{N_q}(c_{u5}u_5 + c_{u4}u_4 - c_{d4}d_4)(1 - N_q b_q) \\ &= \frac{3}{3}(u_5 + u_4 - d_4)(1 - 3b_q) \end{aligned}$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(u_5 + u_4 + d_4)^2}$$

ここで、構成の中で最も重い u_5 は、p^+ の核と考え結合率 b_q には現れないと仮定する。表２、表４の数値を用いると、計算値と観測値には、$300\,eV$ の開きがある。

$$\mid Mass(p^+) \mid = \ 1.672622 * 10^{-27}\, kg \ = \ 9.382723 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 9.382720 - 9.382723 \mid * 10^{+2}\, MeV \ = \ 3.0 * 10^{+2}\, eV$$

4.2 neutron

4.2.1 neutron n^0

$$n^0 = u_5 + d_4^A - d_4 = u_5 + d_4^A + d_4^{AS}$$

$$Spin(n^0) = +\frac{1}{2} + \frac{1}{2} - \frac{1}{2} = +\frac{1}{2}$$

$$Charge(n^0) = +\frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0$$

4.2.2 neutron $n^0_{[\,g\uparrow z\uparrow]}$

$$\begin{aligned} n^0 &= u_5 + d_4^A - d_4 \\ &= (u_5 + u_4 - d_4) + (d_4^A - u_4) \\ &= p^+ - (d_4 + u_4) + \gamma_{d_4} \\ &= p^+ - \gamma_{(d_4+u_4)} + (g_4 + z_4) + \gamma_{d_4} \\ &= p^+ + g_4 - (z_3 + z_3^S + z_2 + \gamma_w) - (\gamma_{(d_4+u_4)} - \gamma_{d_4}) \\ &= p^+ + (g_4 - z_2) - (z_3 + z_3^S) - (\gamma_{(d_4+u_4)} - \gamma_{d_4} + \gamma_w) \end{aligned}$$

$$n^0{}_{[\,Spin(g_4)=+1/2\,,\,Spin(-z_2)=+1/2\,]} \equiv n^0{}_{[\,g\uparrow z\uparrow\,]}$$

$$Mass(n^0) = \frac{1}{3}(c_{u5}u_5 + c_{u4}u_4 - c_{d4}d_4)(1-3b_q) + (\frac{1}{2}(c_{g4}g_4 - c_{z2}z_2) - \frac{1}{2}(c_{z3}z_3 + c_{z3}z_3))(1-4b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(u_5+u_4+d_4+g_4+z_2+z_3+z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(g_4)^2 + (z_2)^2 + (2z_3)^2}{(u_5+u_4+d_4+g_4+z_2+z_3+z_3)^2}$$

$$\mid Mass(n^0) \mid = \; 1.674942 * 10^{-27}\, kg \; = \; 9.395738 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 9.395653 - 9.395738 \mid *10^{+2}\, MeV \; = \; 8.5\, keV$$

4.2.3 neutron $n^0_{[\,g\uparrow z\downarrow\,]}$

$$\begin{aligned} n^0 &= u_5 + d_4^A - d_4 \\ &= (u_5 + u_4 - d_4) + (d_4 + u_4)^A - \gamma_{u_4} \\ &= p^+ + (\gamma_{(d_4+u_4)} - (g_4 + z_4))^A - \gamma_{u_4} \\ &= p^+ + (-g_4 + (z_3 + z_3^S + z_2 + \gamma_w))^A + \gamma_{(u_4+d_4)} - \gamma_{u_4} \\ &= p^+ + (g_4 - \gamma_{g_4}) + z_2^A + (z_3^A + z_3^{MSC}) + \gamma_w + \gamma_{(u_4+d_4)} - \gamma_{u_4} \\ &= p^+ + (g_4 - z_2^S) - (z_3 + z_3^S) + (\gamma_{(u_4+d_4)} - \gamma_{u_4} - \gamma_{g_4} + \gamma_w) \end{aligned}$$

$$n^0{}_{[\,Spin(g_4)=+1/2\,,\,Spin(-z_2^S)=-1/2)\,]} \equiv n^0{}_{[\,g\uparrow z\downarrow\,]}$$

$$Mass(n^0) = \frac{1}{3}(c_{u5}u_5 + c_{u4}u_4 - c_{d4}d_4)(1-3b_q) + (\frac{1}{2}(c_{g4}g_4 - c_{z2}z_2) - \frac{1}{2}(c_{z3}z_3 + c_{z3}z_3))(1-4b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(u_5+u_4+d_4+g_4+z_2+z_3+z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(g_4)^2 + (z_2)^2 + (2z_3)^2}{(u_5+u_4+d_4+g_4+z_2+z_3+z_3)^2}$$

$$\mid Mass(n^0) \mid = \; 1.674942 * 10^{-27}\, kg \; = \; 9.395738 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 9.395653 - 9.395738 \mid *10^{+2}\, MeV \; = \; 8.5\, keV$$

4.3 pion

4.3.1 pion π^-

$$n^0 = p^+ + (d_4^A - u_4)$$
$$= p^+ + ((d_4 - z_3)^A - (u_4 - z_3)) - \mathcal{E}_{z_3}$$

$$\pi^- = (d_4 - z_3)^A - (u_4 - z_3)$$
$$= -(d_4 + u_4) + (z_3 + z_3^S) + \gamma_{d_4}$$
$$= -(d_4 + u_4 - z_3^S) + z_3 + \gamma_{d_4}$$

$$Spin(\pi^-) = (+\frac{1}{2} + \frac{1}{2}) - (+\frac{1}{2} + \frac{1}{2}) = 0$$

$$Charge(\pi^-) = (+\frac{1}{3} - 0)^C - (+\frac{2}{3} - 0) = -1$$

$$Mass(\pi^-) = -\frac{1}{2}(c_{u4}u_4 + c_{d4}d_4)(1 - 2b_q) + \frac{1}{2}(c_{z3}z_3 + c_{z3}z_3)(1 - 2b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(u_4 + d_4 + z_3 + z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(2z_3)^2}{(u_4 + d_4 + z_3 + z_3)^2}$$

$$\mid Mass(\pi^-) \mid = \; 2.483597 * 10^{-28}\, kg \; = \; 1.393196 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 1.395701 - 1.393196 \mid *10^{+2}\, MeV \; = \; 250\, keV$$

4.3.2 pion' π'^-

$$n^0 = p^+ + (d_4^A - u_4)$$
$$= p^+ + ((d_4 + z_3)^A - (u_4 + z_3)) + \mathcal{E}_{z_3}$$

$$\pi'^- = (d_4 + z_3)^A - (u_4 + z_3)$$
$$= -(d_4 + u_4) - (z_3 + z_3^S) + \gamma_{d_4}$$
$$= -(d_4 + u_4 + z_3) - z_3^S + \gamma_{d_4}$$

$$Spin(\pi'^-) = (+\frac{1}{2} - \frac{1}{2}) - (+\frac{1}{2} - \frac{1}{2}) = 0$$

$$Charge(\pi'^-) = (+\frac{1}{3} + 0)^C - (+\frac{2}{3} + 0) = -1$$

$$Mass(\pi'^-) = -\frac{1}{2}(c_{u4}u_4 + c_{d4}d_4)(1 - 2b_q) - \frac{1}{2}(c_{z3}z_3 + c_{z3}z_3)(1 - 2b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(u_4 + d_4 + z_3 + z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(2z_3)^2}{(u_4 + d_4 + z_3 + z_3)^2}$$

$$\mid Mass(\pi'^{-}) \mid = \; 2.484421 * 10^{-28}\, kg \; = \; 1.393658 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 1.395701 - 1.393658 \mid * 10^{+2}\, MeV \; = \; 204\, keV$$

4.4 muon

4.4.1 muon μ^-

$$\begin{aligned}
\pi^- &= (d_4 - z_3)^A - (u_4 - z_3) \\
&= (d_4^A - u_4 + z_3^S) + z_3
\end{aligned}$$

$$\begin{aligned}
\mu^- &= d_4^A - u_4 + z_3^S \\
&= \gamma_{d_4} - (d_4 + u_4) + z_3^S \\
&= -\gamma_{(d_4+u_4)} + (g_4 + z_4) + z_3^S + \gamma_{d_4} \\
&= -\gamma_{(d_4+u_4)} + g_4 - (z_3 + z_3^S + z_2 + \gamma_w) + z_3^S + \gamma_{d_4} \\
&= -\gamma_{(d_4+u_4)} + (g_4 - z_2 - z_3) + (\gamma_{d_4} - \gamma_w)
\end{aligned}$$

$$Spin(\mu^-) = +\frac{1}{2} - \frac{1}{2} + \frac{1}{2} = +\frac{1}{2}$$

$$Charge(\mu^-) = (+\frac{1}{3})^C - \frac{2}{3} + 0 = -1$$

quark-lepton の構成から lepton のみの構成へ崩壊するため、

- $\gamma_{(d_4+u_4)}$ は結合率へ寄与しない
- $n_{g4} = n_{z3} = n_{z2} = 1$ である

とする。

$$Mass(\mu^-) = -\frac{1}{2}(c_{u4}u_4 + c_{d4}d_2) + (c_{g4}g_4 - c_{z2}z_2 - c_{z3}z_3)(1 - 3b_l)$$

$$b_l = 4\pi \frac{(g_4)^2 + (z_2)^2 + (z_3)^2}{(g_4 + z_2 + z_3)^2}$$

$$\mid Mass(\mu^-) \mid = \; 1.880542 * 10^{-28}\, kg \; = \; 1.054907 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 1.056583 - 1.054907 \mid * 10^{+2}\, MeV \; = \; 168\, keV$$

4.4.2 muon' μ'^{-}

$$\begin{aligned}\pi^- &= (d_4 + z_3)^A - (u_4 + z_3) \\ &= (d_4^A - u_4 - z_3^S) - z_3\end{aligned}$$

$$\begin{aligned}\mu'^- &= d_4^A - u_4 - z_3^S \\ &= \gamma_{d_4} - (d_4 + u_4) - z_3^S \\ &= -\gamma_{(d_4+u_4)} + (g_4 + z_4) - z_3^S + \gamma_{d_4} \\ &= -\gamma_{(d_4+u_4)} + g_4 - (z_3 + z_3^S + z_2 + \gamma_w) - z_3^S + \gamma_{d_4} \\ &= -\gamma_{(d_4+u_4)} + (g_4 - z_2 - z_3^S) + (\gamma_{d_4} - \gamma_w) - \mathcal{E}_{z_3}\end{aligned}$$

$$Spin(\mu'^-) = +\frac{1}{2} - \frac{1}{2} - \frac{1}{2} = -\frac{1}{2}$$

$$Charge(\mu'^-) = (+\frac{1}{3})^C - \frac{2}{3} - 0 = -1$$

$$Mass(\mu'^-) = -\frac{1}{2}(c_{u4}u_4 + c_{d4}d_4) + (c_{g4}g_4 - c_{z2}z_2 - c_{z3}z_3)(1 - 3b_l)$$

$$\cdot\, b_l = 4\pi \frac{(g_4)^2 + (z_2)^2 + (z_3)^2}{(g_4 + z_2 + z_3)^2}$$

$$\mid Mass(\mu'^-) \mid = \mid Mass(\mu^-) \mid$$

4.5 pion 構成式の変形

$$\begin{aligned}\pi^- &= (d_4 - z_3)^A - (u_4 - z_3) \\ &= (d_4^A - d_4 + z_3^S) + (d_4 - u_4 + z_3) \\ &= c^- + s'^-\end{aligned}$$

$$\begin{aligned}\pi'^- &= (d_4 + z_3)^A - (u_4 + z_3) \\ &= (d_4^A - d_4 - z_3^S) + (d_4 - u_4 - z_3) \\ &= c'^- + s^-\end{aligned}$$

$$s^- = d_4 - u_4 - z_3\ , \qquad s'^- = d_4 - u_4 + z_3$$
$$c^- = d_4^A - d_4 + z_3^S\ , \qquad c'^- = d_4^A - d_4 - z_3^S$$

4.6 StrangeQuark : Snon

4.6.1 Snon s^-

$$s^- = d_4 - u_4 - z_3$$

$$Spin(s^-) = +\frac{1}{2} - \frac{1}{2} + \frac{1}{2} = +\frac{1}{2}$$

$$Charge(s^-) = +\frac{1}{3} - \frac{2}{3} - 0 = -\frac{1}{3}$$

$$Mass(s^-) = \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)(1 - 2b_q) - c_{z3}z_3(1 - b_l)$$

$$\cdot\, b_q = 4\pi\frac{(u_4)^2 + (d_4)^2}{(u_4 + d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(u_4 + d_4 + z_3)^2}$$

$$\mid Mass(s^-) \mid = \; 1.486809 * 10^{-28}\, kg \; = \; 8.340385 * 10^{+1}\, MeV$$

$$\frac{|s^-|}{(1/2)(d_4 + u_4)} \; = \; 29.02$$

4.6.2 Snon s'^-

$$s'^- = d_4 - u_4 + z_3$$

$$Spin(s'^-) = +\frac{1}{2} - \frac{1}{2} - \frac{1}{2} = -\frac{1}{2}$$

$$Charge(s'^-) = +\frac{1}{3} - \frac{2}{3}0 = -\frac{1}{3}$$

$$Mass(s'^-) = \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)(1 - 2b_q) + c_{z3}z_3(1 - b_l)$$

$$\cdot\, b_q = 4\pi\frac{(u_4)^2 + (d_4)^2}{(u_4 + d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(u_4 + d_4 + z_3)^2}$$

$$\mid Mass(s'^-) \mid = \; 1.487633 * 10^{-28}\, kg \; = \; 8.345010 * 10^{+1}\, MeV$$

$$\frac{|s'^-|}{(1/2)(d_4 + u_4)} \; = \; 29.03$$

4.7 CharmQuark : Ckon

4.7.1 Ckon c^-

$$c^- = d_4^A - d_4 + z_3^S = \gamma_{d_4} - (d_4 + d_4) + z_3^S$$

$$Spin(c^-) = +\frac{1}{2} - \frac{1}{2} + \frac{1}{2} = +\frac{1}{2}$$

$$Charge(c^-) = (+\frac{1}{3})^C - \frac{1}{3} + 0 = -\frac{2}{3}$$

$$Mass(c^-) = -\frac{1}{2}(c_{d4}d_4 + c_{d4}d_4)(1 - 2b_q) + (c_{z3}z_3)(1 - b_l)$$

$$\cdot\, b_q = 4\pi\frac{(2d_4)^2}{(2d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(2d_4 + z_3)^2}$$

$$\mid Mass(c^-) \mid = \ 5.942893 * 10^{-28}\, kg \ = \ 3.333719 * 10^{+2}\, MeV$$

4.7.2 Ckon c'^-

$$c'^- = d_4^A - d_4 - z_3^S = \gamma_{d_4} - (d_4 + d_4) - z_3^S$$

$$Spin(c'^-) = +\frac{1}{2} - \frac{1}{2} - \frac{1}{2} = -\frac{1}{2}$$

$$Charge(c'^-) = (+\frac{1}{3})^C - \frac{1}{3} - 0 = -\frac{2}{3}$$

$$Mass(c'^-) = -\frac{1}{2}(c_{d4}d_4 + c_{d4}d_4)(1 - 2b_q) - (c_{z3}z_3)(1 - b_l)$$

$$\cdot\, b_q = 4\pi\frac{(2d_4)^2}{(2d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(2d_4 + z_3)^2}$$

$$\mid Mass(c'^-) \mid = \ 5.943718 * 10^{-28}\, kg \ = \ 3.334181 * 10^{+2}\, MeV$$

4.8 K meson

4.8.1 K meson k^-

$$k^- = s^- - u_4$$

$$Spin(k^-) = +\frac{1}{2} - \frac{1}{2} = 0$$

$$Charge(k^-) = -\frac{1}{3} - \frac{2}{3} = -1$$

$$Mass(k^-) = (\,(c_{u4} + c_{d4})|s^-| - c_{u4}u_4\,)(1 - 3b_q)$$

$$\cdot\, b_q = 4\pi\frac{(u_4)^2}{(|s^-| + u_4)^2}$$

$$\mid Mass(k^-) \mid = \ 8.797607 * 10^{-28}\, kg \ = \ 4.935096 * 10^{+2}\, MeV$$

4.8.2 K' meson k'^{-}

$$k'^{-} = s'^{-} - u_4^S = s'^{-} + u_4^A = s'^{-} - u_4 + \gamma_{u_4}$$

$$Spin(k'^{-}) = -\frac{1}{2} - (+\frac{1}{2})^S = 0$$

$$Charge(k'^{-}) = -\frac{1}{3} - \frac{2}{3} = -1$$

$$Mass(k'^{-}) = (\,(c_{u4} + c_{d4})|s'^{-}| - c_{u4}u_4\,)(1 - 3b_q)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2}{(|s'^{-}| + u_4)^2}$$

$$|\, Mass(k'^{-})\,| = \; 8.802588 * 10^{-28}\, kg \; = \; 4.937890 * 10^{+2}\, MeV$$

4.9 D meson

4.9.1 D meson D^{-}

$$D^{-} = c^{-} - d_4$$

$$Spin(D^{-}) = +\frac{1}{2} - \frac{1}{2} = 0$$

$$Charge(D^{-}) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(D^{-}) = (\,(c_{d4} + c_{d4})|c^{-}| - c_{d4}d_4\,)(1 - 3b_q)$$

$$\cdot\, b_q = 4\pi \frac{(d_4)^2}{(|c^{-}| + d_4)^2}$$

$$|\, Mass(D^{-})\,| = \; 3.516421 * 10^{-27}\, kg \; = \; 1.972568 * 10^{0}\, GeV$$

4.9.2 D' meson D'^{-}

$$D'^{-} = c'^{-} - d_4^S = c'^{-} - d_4 + \gamma_{d_4}$$

$$Spin(D'^{-}) = -\frac{1}{2} - (+\frac{1}{2})^S = 0$$

$$Charge(D'^{-}) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(D'^{-}) = (\,(c_{d4} + c_{d4})|c'^{-}| - c_{d4}d_4\,)(1 - 3b_q)$$

$$\cdot\, b_q = 4\pi \frac{(d_4)^2}{(|c'^{-}| + d_4)^2}$$

$$|\, Mass(D'^{-})\,| = \; 3.516919 * 10^{-27}\, kg \; = \; 1.972847 * 10^{0}\, GeV$$

4.10 Ds meson

4.10.1 Ds meson Ds^-

$$Ds^- = c^- + (s^-)^S = c^- - (s^-)^A = c^- + (d_4 - u_4 - z_3) - \gamma_{s^-}$$

$$Spin(Ds^-) = +\frac{1}{2} + (+\frac{1}{2})^S = 0$$

$$Charge(Ds^-) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(Ds^-) = (\,(c_{d4} + c_{d4})|c^-| + \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)\,)(1 - 4b_q) - (c_{z3}z_3)(1 - b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(|c^-| + u_4 + d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(z_3)^2}{(|c^-| + u_4 + d_4 + z_3)^2}$$

$$|\, Mass(Ds^-)\,| = \, 3.549017 * 10^{-27}\, kg \, = \, 1.990853 * 10^{0}\, GeV$$

4.10.2 Ds' meson Ds'^-

$$Ds'^- = c^- + s'^- = c^- + (d_4 - u_4 + z_3)$$

$$Spin(Ds'^-) = +\frac{1}{2} - \frac{1}{2} = 0$$

$$Charge(Ds'^-) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(Ds'^-) = (\,(c_{d4} + c_{d4})|c^-| + \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)\,)(1 - 4b_q) + (c_{z3}z_3)(1 - b_l)$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(|c^-| + u_4 + d_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(z_3)^2}{(|c^-| + u_4 + d_4 + z_3)^2}$$

$$|\, Mass(Ds'^-)\,| = \, 3.548935 * 10^{-27}\, kg \, = \, 1.990807 * 10^{0}\, GeV$$

4.10.3 D's meson $D's^-$

$$D's^- = c'^- + s^- = c'^- + (d_4 - u_4 - z_3)$$

$$Spin(D's^-) = -\frac{1}{2} + \frac{1}{2} = 0$$

$$Charge(D's^-) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(Ds'^{-}) = (\,(c_{d4}+c_{d4})|c'^{-}| + \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)\,)(1-4b_q) - (c_{z3}z_3)(1-b_l)$$

$$\cdot\, b_q = 4\pi\frac{(u_4)^2+(d_4)^2}{(|c^-|+u_4+d_4+z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(|c^-|+u_4+d_4+z_3)^2}$$

$$|\, Mass(D's^-)\,| = 3.549517 * 10^{-27}\, kg = 1.991133 * 10^{0}\, GeV$$

4.10.4 Ds meson $D's'^{-}$

$$D's'^{-} = c'^{-} + (s'^{-})^{S} = c'^{-} - (s'^{-})^{A} = c'^{-} + (d_4 - u_4 + z_3) - \gamma_{s'^{-}}$$

$$Spin(D's'^{-}) = -\frac{1}{2} + (-\frac{1}{2})^{S} = 0$$

$$Charge(D's'^{-}) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(D's'^{-}) = (\,(c_{d4}+c_{d4})|c'^{-}| + \frac{1}{2}(c_{d4}d_4 - c_{u4}u_4)\,)(1-3b_q) + (c_{z3}z_3)(1-b_l)$$

$$\cdot\, b_q = 4\pi\frac{(u_4)^2+(d_4)^2}{(|c'^{-}|+u_4+d_4+z_3)^2}$$

$$\cdot\, b_l = 4\pi\frac{(z_3)^2}{(|c'^{-}|+u_4+d_4+z_3)^2}$$

$$|\, Mass(D's'^{-})\,| = 3.549434 * 10^{-27}\, kg = 1.991087 * 10^{0}\, GeV$$

4.11 WeakBoson

$$\pi^- = c^- + s'^- = (c^- + s^-) + (z_3 + z_3) = (c'^- + s'^-) + (z_3 + z_3)^S$$

$$\pi'^- = c'^- + s^- = (c^- + s^-) - (z_3 + z_3)^S = (c'^- + s'^-) - (z_3 + z_3)$$

4.11.1 WeakBoson w^-

$$w^- = c^- + s^-$$

$$Spin(w^-) = +\frac{1}{2} + \frac{1}{2} = +1$$

$$Charge(w^-) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(w^-) = (\,(c_{d4}+c_{d4})|c^-| + (c_{u4}+c_{d4})|s^-|\,)(1-4b_q)$$

$$\cdot\, b_q = 4\pi\frac{(|c^-|)^2+(|s^-|)^2}{(|c^-|+|s^-|)^2}$$

$$|\, Mass(w^-)\,| = 1.478814 * 10^{-25}\, kg = 8.295541 * 10^{+1}\, GeV$$

4.11.2 WeakBoson w'^{-}

$$w'^{-} = c'^{-} + s'^{-}$$

$$Spin(w'^{-}) = -\frac{1}{2} - \frac{1}{2} = -1$$

$$Charge(w'^{-}) = -\frac{2}{3} - \frac{1}{3} = -1$$

$$Mass(w'^{-}) = (\,(c_{d4} + c_{d4})|c'^{-}| + (c_{u4} + c_{d4})|s'^{-}|\,)(1 - 4b_q)$$

$$\cdot\, b_q = 4\pi \frac{(|c'^{-}|)^2 + (|s'^{-}|)^2}{(|c'^{-}| + |s'^{-}|)^2}$$

$$|\, Mass(w'^{-})\,| = \; 1.478964 * 10^{-25}\, kg \; = \; 8.296379 * 10^{+1}\, GeV$$

4.11.3 WeakBoson W^{-}

$$\begin{aligned} W^{-} &= \gamma_4 + \pi^{-} \\ &= \gamma_4 - (d_4 + u_4) + (z_3 + z_3^S) + \gamma_{d_4} \\ &= \gamma_4 - \gamma_{(d_4+u_4)} + (g_4 + z_4) + (z_3 + z_3^S) + \gamma_{d_4} \\ &= \gamma_4 - \gamma_{(d_4+u_4)} + (g_4 - z_2) + (\gamma_{d_4} - \gamma_w) \\ &= (d_4 + u_4 + g_4 + z_4) + (g_4 - z_2) - \gamma_{(d_4+u_4)} + (\gamma_{d_4} - \gamma_w) \end{aligned}$$

$$Spin(W^{-}) = +1 + 0 = +1$$

$$Charge(W^{-}) = 0 - 1 = -1$$

$$\begin{aligned} Mass(W^{-}) = (c_{d4}d_4 + c_{u4}u_4)(1 - 2b_q) - \frac{1}{2}(c_{d4}d_4 + c_{u4}u_4) \\ +(\,(c_{g4}g_4 + c_{z4}z_4) + \frac{1}{2}(c_{g4}g_4 - c_{z2}z_2)\,)(1 - 4b_l) \end{aligned}$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(d_4 + u_4 + g_4 + z_4 + g_4 + z_2)^2}$$

$$\cdot\, b_l = 4\pi \frac{(2g_4)^2 + (z_4)^2 + (z_2)^2}{(d_4 + u_4 + g_4 + z_4 + g_4 + z_2)^2}$$

$$|\, Mass(W^{-})\,| = \; 1.398306 * 10^{-25}\, kg \; = \; 7.843922 * 10^{+1}\, GeV$$

4.11.4 WeakBoson W'^{-}

$$
\begin{aligned}
W'^{-} &= \gamma_4 + \pi'^{-} \\
&= \gamma_4 - (d_4 + u_4) - (z_3 + z_3^S) + \gamma_{d_4} \\
&= \gamma_4 - \gamma_{(d_4+u_4)} + (g_4 + z_4) - (z_3 + z_3^S) + \gamma_{d_4} \\
&= \gamma_4 - \gamma_{(d_4+u_4)} + (g_4 - z_2) - (z_3 + z_3^S) - (z_3 + z_3^S) + (\gamma_{d_4} - \gamma_w) \\
&= (d_4 + u_4 + g_4 + z_4) + (g_4 - z_2) - (z_3 + z_3^S) - (z_3 + z_3^S) - \gamma_{(d_4+u_4)} + (\gamma_{d_4} - \gamma_w)
\end{aligned}
$$

$$Spin(W'^{-}) = +1 + 0 = +1$$

$$Charge(W'^{-}) = 0 - 1 = -1$$

$$
\begin{aligned}
Mass(W'^{-}) &= (c_{d4} d_4 + c_{u4} u_4)(1 - 2b_q) - \frac{1}{2}(c_{d4} d_4 + c_{u4} u_4) \\
&\quad + (\,(c_{g4} g_4 + c_{z4} z_4) + \frac{1}{2}(c_{g4} g_4 - c_{z2} z_2) - \frac{2}{2}(c_{z3} z_3 + c_{z3} z_3)\,)(1 - 8b_l)
\end{aligned}
$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(d_4 + u_4 + g_4 + z_4 + g_4 + z_2 + 4z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(2g_4)^2 + (z_4)^2 + (z_2)^2 + (4z_3)^2}{(d_4 + u_4 + g_4 + z_4 + g_4 + z_2 + 4z_3)^2}$$

$$\mid Mass(W'^{-}) \mid = \; 3.783764 * 10^{-25}\, kg \; = \; 2.122536 * 10^{+2}\, GeV$$

4.12 零電荷素粒子

4.12.1 pion π^0

$$
\begin{aligned}
\pi^0 &= \pi^- + (\pi^-)^A \\
&= (d_4 - z_3)^A - (u_4 - z_3) + (d_4 - z_3) - (u_4 - z_3)^A \\
&= \gamma_{d_4} - (d_4 + u_4) + (z_3 + z_3^S) - \gamma_{u_4} + (d_4 + u_4) - (z_3 + z_3^S) \\
&= \gamma_{(d_4+u_4)} - (d_4 + u_4) - (g_4 + z_4) + (\gamma_{d_4} - \gamma_{u_4}) \\
&= \gamma_{(d_4+u_4)} - (d_4 + u_4) - (g_4 - z_2) + (z_3 + z_3^S) + (\gamma_{d_4} - \gamma_{u_4} + \gamma_w)
\end{aligned}
$$

$$Spin(\pi^0) = +0 + 0 = 0$$

$$Charge(\pi^0) = -1 + (-1)^C = 0$$

$$
\begin{aligned}
Mass(\pi^0) &= (c_{d4} d_4 + c_{u4} u_4) - \frac{1}{2}(c_{u4} u_4 + c_{d4} d_4)(1 - 2b_q) \\
&\quad + (\,-\frac{1}{2}(c_{g4} g_4 - c_{z2} z_2) + \frac{1}{2}(c_{z3} z_3 + c_{z3} z_3)\,)(1 - 4b_l)
\end{aligned}
$$

$$\cdot\, b_q = 4\pi \frac{(u_4)^2 + (d_4)^2}{(d_4 + u_4 + g_4 + z_2 + 2z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(g_4)^2 + (z_2)^2 + (2z_3)^2}{(d_4 + u_4 + g_4 + z_2 + 2z_3)^2}$$

$$\mid Mass(\pi^0) \mid = 2.362263 * 10^{-28}\, kg = 1.325133 * 10^{+2}\, MeV$$

$$\mid Observation - Calculation \mid = \mid 1.349766 - 1.325133 \mid * 10^{+2}\, MeV = 2.46\, MeV$$

4.12.2 WeakBoson Z^0

$$\begin{aligned} Z^0 &= (W^- + z_4) + (W^- + z_4)^A \\ &= W^- + (\,\gamma_4 - \gamma_{(d_4+u_4)} + (g_4 - z_2) + (\gamma_{d_4} - \gamma_w)\,)^A + (z_4 + z_4^A) \\ &= W^- + \gamma_4 - \gamma_{(d_4+u_4)} - (g_4 - z_2^S) + (z_4 - z_4^S) + (\gamma_{d_4} + \gamma_{g_4} - \gamma_w) \\ &= (c^- + s^-) + (d_4 + u_4 + g_4 + z_4) - \gamma_{(d_4+u_4)} - (g_4 - z_2^S) + (z_4 - z_4^S) + (\gamma_{d_4} + \gamma_{g_4} - \gamma_w) \end{aligned}$$

$$Spin(Z^0) = (+1 - \frac{1}{2}) + (+1 - \frac{1}{2}) = +1$$

$$Charge(Z^0) = (-1 + 0) + (-1 + 0)^C = 0$$

$$\begin{aligned} Mass(Z^0) = {} & (\,(c_{d4} + c_{d4})|c^-| + (c_{u4} + c_{d4})|s^-|\,)(1 - 4b_q) \\ & + (c_{u4}u_4 + c_{d4}d_4)(1 - 2b_q) - (c_{u4}u_4 + c_{d4}d_4) \\ & + (\,(c_{g4}g_4 + c_{z4}z_4) - \frac{1}{2}(c_{g4}g_4 - c_{z2}z_2) + \frac{1}{2}(c_{z4}z_4 - c_{z4}z_4)\,)(1 - 6b_l) \end{aligned}$$

$$\cdot\, b_q = 4\pi \frac{(|c^-|)^2 + (|s^-|)^2 + (d_4)^2 + (u_4)^2}{(|c^-| + |s^-| + d_4 + u_4 + g_4 + z_4 + g_4 + z_2 + z_4 + z_4)^2}$$

$$\cdot\, b_l = 4\pi \frac{(2g_4)^2 + (3z_4)^2 + (z_2)^2}{(|c^-| + |s^-| + d_4 + u_4 + g_4 + z_4 + g_4 + z_2 + z_4 + z_4)^2}$$

$$\mid Mass(Z^0) \mid = 1.576718 * 10^{-25}\, kg = 8.844739 * 10^{+1}\, GeV$$

4.13 JPsion J/ψ^0

$$\begin{aligned} J/\psi^0 &= (c^-) + (c^-)^A \\ &= (c^-) + (d_4^A - d_4 + z_3^S)^A \\ &= (c^- - d_4^A + d_4) + z_3^{SA} \\ &= (c^- - u_4 + d_4) + (d_4 + u_4) - z_3 - \gamma_{d_4} \\ &= (c^- - u_4 + d_4) + \gamma_{((d_4+u_4)} - (g_4 + z_4 + z_3) - \gamma_{d_4} \end{aligned}$$

$$Spin(J/\psi^0) = +\frac{1}{2} + \frac{1}{2} = +1$$

$$Charge(J/\psi^0) = -\frac{2}{3} + (-\frac{2}{3})^C = 0$$

$$Mass(J/\psi^0) = ((c_{d4} + c_{d4})|c^-| - c_{u4}u_4 + c_{d4}d_4)(1 - 4b_q) + (c_{u4}u_4 + c_{d4}d_4) \\ -(c_{g4}g_4 + c_{z4}z_4 + c_{z3}z_3)(1 - 3b_l)$$

$$\cdot\, b_q = 4\pi \frac{(d_4)^2 + (u_4)^2}{(|c^-| + d_4 + u_4 + g_4 + z_4 + z_3)^2}$$

$$\cdot\, b_l = 4\pi \frac{(g_4)^2 + (z_4)^2 + (z_3)^2}{(|c^-| + d_4 + u_4 + g_4 + z_4 + z_3)^2}$$

$$\mid Mass(J/\psi^0) \mid = \ 3.607072 * 10^{-27}\, kg \ = \ 2.023419 * 10^0\, GeV$$

4.14 Deuteron ${}^2_1D$

$${}^2_1D = p^+ + n^0$$
$$= p^+ + p^+ + (g_4 - z_2) - (z_3 + z_3^S) - (\gamma_{(d_4+u_4)} - \gamma_{d_4} + \gamma_w)$$

$$Mass({}^2_1D) = \frac{2}{3}(c_{u_5}u_5 + c_{u_4}u_4 + c_{d_4}d_4)(1 - 6b_q) \\ + \frac{2}{2 + (2-1)}(\ \frac{1}{2}(c_{g_4}g_4 - c_{z_2}z_2) - \frac{1}{2}(c_{z_3}z_3 + c_{z_3}z_3)\ )(1 - 4b_l)$$

$$\cdot\, b_q = 4\pi\, \frac{(2u_4)^2 + (2d_4)^2}{(2(u_5 + u_4 + d_4) + (g_4 + z_2) + 2z_3)^2}$$

$$\cdot\, b_l = 4\pi\, \frac{(g_4)^2 + (z_2)^2 + (2z_3)^2}{(2(u_5 + u_4 + d_4) + (g_4 + z_2) + 2z_3)^2}$$

$$\mid Mass({}^2_1D) \mid = \ 3.343639 * 10^{-27}\, kg \ = \ 1.875644 * 10^{+3}\, MeV$$

$$\mid Mass(p^+) \mid + \mid Mass(n^0) \mid - \mid Mass({}^2_1D) \mid = \ 2.2019\, MeV$$

$$\mid Observation - Calculation \mid$$

$$= \mid 1.875612 - 1.875644 \mid *10^{+3}\, MeV \ = \ 3.20 * 10^{-2}\, MeV$$

5 後書き

このモデルでは、Spin や Charge の制約以外に構成式を導く原理がないため、無数の構成式すなわち素粒子が存在することになる。さらに、x^A 記号の消去という制約以外に構成式の変形制約がないため、多様な構成式の変形すなわち多様な素粒子の崩壊過程が存在するということになる。

これまで $M_{(n\,,\,\gamma_Q)}$ において $n \leq 6$ としてきたが、n の上限を定める法則・原理はない。Planck's mass を上限としても $n < 11$ となるため、巨大な質量を持つ素粒子が存在することになる。

もし、$M_{(n\,,\,\gamma_Q)}$ における誘電率 ϵ_0 を制御できるのであれば、質量の制御が可能となってしまう。さらに、物質内の誘電率 ϵ_0 が、物質構成の原子と結晶構造によって相対的に変化するのであれば、その影響下にある電子などの質量も変化してしまう。

最後まで読んでくれて、ありがとう。

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