Contents

The Higgs Vacuum.The Particles Of The Standard Model And The Compliance With the Energy-Momentum Equation. The Necessary Existence Of the Axion. Stop Quark Mass.

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Abstract

In this paper it is demonstrated that all the masses of the standard model particles; including the Higgs boson h; with nonzero rest mass, comply with the equation of energy-momentum. The model Higgs vacuum corresponds to a virtual vacuum, for which the contribution of particles with zero rest mass is null (photon, gluon, graviton) .With the best values of the masses of the particles (Particle Data Group), it is found that axion mass has to be extremely small.

Also the theoretical model Higgs vacuum, a completely new model based on the lattice R8 and sixteen matrix elements of energy; corresponding to the four solutions of the equation of energy-momentum (isomorphism with the four components of the scalar field. One complex doublet); to be factored into two factors with real and imaginary components of energy.

Of this new model Higgs vacuum; naturally get the beta angle. Stop quark mass is obtained by solving the equation of radiative mass correction Higss boson, h, to one loop. The exact determination of the beta angle, allows calculating the mass of the stop of about 1916 GeV. Similarly, a mass for axion is proposed of around 110 μeV.

I thank God, Holy Father, creator of all things. And our Lord Jesus Christ, our savior.

1 Introduction

Up to the date the model of Higgs's vacuum bases on the potential of the Mexican hat. But it has been obviated, the most fundamental thing: Higgs's vacuum must meet with the energy-momentum equation. Also there have been ignored the four solutions of positive energy of this equation.

The interaction matrix of these four solutions; on the one hand; generate 16 particles with nonzero rest mass of the standard model. Since the number of known particles of the standard model with non-zero mass at rest, up to the limit of the value of the the Higgs vacuum (246.2196509 GeV) are 15: 6 leptons, 6 quarks, one boson W (+ -) , one Z boson and the Higgs boson h; then necessarily there must be another particle with nonzero rest mass. For various theoretical reasons that will be displayed; this particle has to be the axion. Moreover the SU(4) group derived from these four solutions is isomorphic to all projections summation of all spins. Similarly, there is an isomorphism of the dimension of the group SU(4) which relates it to the famous 26 dimensional superstring theory. By these, 26; dimensions are exactly the sum of the 16 non-zero mass particles at rest; plus the 10 particles with zero rest mass; ie: 8 gluons + 1 photon + 1 graviton (isomorphism with the ten spatial dimensions).

$$10d \equiv 8g + 1\gamma + 1G \ ; \ 26d \equiv 6l + 6q + 1W \pm + 1Z + 1h + 1\,axion + 8g + 1\gamma + 1G$$

$$SU(4) \equiv 26d - 10d \equiv \sum_{s} 2s + 1 = 15$$

2 The Equation Of Energy-Momentum And Five Solutions. Factoring E^2

This equation has five different solutions; by factoring in two products; whose terms are composed of a real and an imaginary component (alternating energy and momentum with real and imaginary values). Four solutions are of positive energy; and a solution of negative energy. The amount of particles of the standard model with nonzero rest mass, up to the limit of the value of the Higgs vacuum; is exactly the interaction matrix of 4 x 4 = 16; of the four solutions of positive energy. The matrix (4 positive energy solutions,+1 negative energy solution) x (4 solutions positive energy,+1 negative energy solution) = 25 particles of the standard model; Therefore particles with zero rest mass, as well as particles with nonzero rest mass. This matrix of twenty five components; unification group is derived, SU(5) = SU(3)SU(2)U(1).

But to be consistent with the equation of the number of dimensions of space-time, 11; requires that the total amount of particles of the standard model to the limit of the Higgs vacuum value, has to be 26. Thus, a very important and necessary double match occurs; namely: Correlation between, 26d -11d and dim[SU(4)]. And the necessary existence of the axion, as more simple and natural solution to the strong interaction CP problem.

From Wikipedia, the free encyclopedia. http://en.wikipedia.org/wiki/Peccei%E2%80%93Quinn_theory “Peccei–Quinn symmetry is a possible additional ingredient—a global U(1) symmetry under which a complex scalar field is charged. This symmetry is spontaneously broken by the VEV obtained by this scalar field, and the axion is the massless goldstone boson of this symmetry breaking. If the symmetry is a gauge symmetry then the axion is "eaten up" by the gauge boson, meaning that the gauge boson becomes massive and the axion does not exist anymore as a physical degree of freedom (see Higgs mechanism). This is phenomenologically desirable because it leaves no massless particles, which are indeed not seen experimentally.”

$E_1^2 = (imc^2 + pc)(-imc^2 + pc)$
$E_2^2 = (imc^2 - pc)(-imc^2 - pc)$
$E_3^2 = (mc^2 + ipc)(mc^2 - ipc)$
$E_4^2 = (-mc^2 + ipc)(-imc^2 - ipc)$
$-E_5^2 = i(mc^2 + ipc)(imc^2 + pc)$

$4\ positive\ energy\ solutions\ x\ four\ components\ (2\ real + 2\ imaginary) = 16$

$4^2 = 6\ \ leptons + 6\ \ quarks + 1W^{\pm} + 1Z + 1h + 1\ axion$

$dim[SU(4)] = \sum_s 2s + 1 = 6\ \ leptons + 6\ \ quarks + 1W^{\pm} + 1Z + 1h$

$2\sum_{n=1}^{15} n = dim[Laticce\ R8] = 240\ ;\ \sum_{n=1}^{16} n = 136 = \lfloor \alpha^{-1} \rfloor - 1 = \lfloor 137.035999173 \rfloor - 1$

$6\ leptons + 6\ quarks + 1W^{\pm} + 1Z + 1h + 8g + 1\gamma + 1G = 25 \rightarrow SU(5) \rightarrow GUT$

$6\ \ leptons + 6\ \ quarks + 1W^{\pm} + 1Z + 1h + 1axion + 8g + 1\gamma + 1G = 26d = (5+i)(5-i)$

$SU(8) - \sum_{F_n/(240/8)} SU(F_n) = 6\ \ leptons + 6\ \ quarks + 1W^{\pm} + 1Z + 1h + 1axion + 8g + 1\gamma + 1G = 26d$

3 Model Higgs Vacuum: Virtual Vacuum With Contribution To The Total Mass, Zero; Of Particles With Zero Rest Mass. Energy-Momentum Equation. Vector Sum Of The 15 Known Particles Of The Standard Model + 1 axion.

The virtual model Higgs vacuum we present, is based on the facts that on the one hand particles with zero rest mass can not contribute to the total mass of the Higgs vacuum; and otherwise; to be virtual particles we can not assign a specific value of momentum. The only knowable value is the non-zero rest mass. Thus for the vector sum of the energy-momentum equation, of the 16 particles with non-zero mass of the standard model is due to meet:

$m_h = Higgs\ boson\ ;\ m_a = axion\ ;\ l = leptons\ ;\ q = quarks\ ;\ B = bosons\ ;\ VH = Higgs\ Vacuum = 246.2196509\ GeV$

1. $\left(\sum_{l=1}^{6} m_l^2\right) + \left(\sum_{q=1}^{6} m_q^2\right) + \left(\sum_{B=1}^{2} m_B^2\right) + m_h^2 + m_a^2 = (VH)^2$

2. Quarks masses: $m_u = 0.0216\ GeV\ ;\ m_d = 0.048\ GeV\ ;\ m_s = 0.935\ GeV\ ;\ m_c = 1.275\ GeV\ ;\ m_b = 4.18\ GeV\ ;\ m_t = 173.2\ GeV$

3. Leptons masses: $m_e = 5.109989276 \cdot 10^{-4}\ GeV\ ;\ m_\mu = 0.1056583714\ GeV\ ;\ m_\tau = 1.776820438\ GeV\ ;\ \sum_{\nu=1}^{3} m_\nu = 3.2 \cdot 10^{-10}\ GeV$

4. Bosons masses: $m_W = 80.384\ GeV\ ;\ m_Z = 91.1876\ GeV\ ;\ m_h(h \to \gamma\gamma) = 125.8$ (CMS, ATLAS)

5. $m_h = \sqrt{(VH)^2 - \left(\sum_{l=1}^{6} m_l^2\right) - \left(\sum_{q=1}^{6} m_q^2\right) - \left(\sum_{B=1}^{2} m_B^2\right) - m_a^2}\ ;\ m_h = 125.8013\ GeV$

3.1 The Vector Sum of the Number of Particles of the Standard Model with Nonzero Rest Mass. Calculation of Higgs Vacuum.

6. $4^2 = 6\ leptons + 6\ quarks + 1W^\pm + 1Z + 1h + 1\ axion = 16$

7. $\sqrt{\sum_{n=1}^{16} n^2} = \overrightarrow{S}(16)\ ;\ \left\lfloor \overrightarrow{S}(16) \right\rfloor = 38 = 3c \cdot 6\ leptons + 6\ quarks + 1W^\pm + 1Z + 1h + 1\ axion + 8g + 1\gamma + 1G$

8. $\left[\exp\left(-\overrightarrow{S}(16)\right) \cdot m_{PK} \cdot \frac{4 \cdot \sin\beta}{\pi}\right] \Big/ \left(1 + \frac{1}{\ln(m_Z/m_e) \cdot 240}\right) = VH\ ;\ 2\sum_{n=1}^{15} n = 240$

3.2 The Vector Sum of the Number of Particles of the Standard Model with Nonzero Rest Mass and Zero Rest Mass. Calculation of Higgs Vacuum.

9. $\sqrt{\sum_{n=1}^{26} n^2} = \overrightarrow{S}(26)$

10. $\left[\exp\left(-\overrightarrow{S}(26)/2\right) \cdot m_{PK} \cdot \sqrt{5}\right] \Big/ (m_W/m_Z) = VH$

3.3 The Vector Sum of the Number of Particles of the Standard Model with Zero Rest Mass. Calculation of Higgs Vacuum.

11. $\sum_{n=1}^{10} n^2 = \overrightarrow{S^2}(10)$

12. $\left[\exp\left(-\overrightarrow{S^2}(10)/10\right) \cdot m_{PK}\right] \cdot \sin^{-10}\beta \cdot \left(1 + \frac{1}{\overrightarrow{S^2}(10)\cdot\sin^3\beta}\right) = VH$

4 The beta angle: supersymmetry.

The group SU(4) is what determines the beta angle. First, the whole circle is divided in $2 \cdot SU(4) = 30$, with a factor of two due to the particles plus sparticles. So the double angle beta is expressed by:

7. $\beta = \frac{2\pi}{2} - \frac{2\pi}{2\cdot 15} = 84^{\circ}$

4.1 Main mathematical properties of the angle β

- $(\sin 2\beta - \cos 2\beta)^2 = 1 + \sin(2\pi/15) = VH/\upsilon$; $\upsilon \simeq 175\ GeV$
- $\cos\beta = \sin^2(2\theta_{13}) \rightarrow$ neutrino mixing angle θ_{13}
- $\sin 2\beta \simeq m_u^2/m_d^2 \rightarrow (0.048\ GeV)^2 \cdot \sin(84^{\circ} \cdot 2) = (0.021886\ GeV)^2$
- $(\sin\beta - \cos\beta) \simeq 10/\left(\varphi^3 + 7\right)$; $\varphi = (1+\sqrt{5})/2$
- $(\sin\beta + \cos\beta) \simeq \sin^{-1}(2\pi/\pi)$
- $\cos\theta_W - \cos^2\theta_W = \cos\beta$
- $(\cos\beta/\sin\theta_c) \simeq z = \frac{\sqrt{m_u/m_d}}{1+(m_u/m_d)}$; θ_c = Cabibbo angle
- $\Omega_b \simeq 2/\left(10 + \cos^4 2\beta\right)$

4.2 Calculations applied the β angle: the standard model particles.

$\upsilon \simeq 175\ GeV$

13. $VH/(i+\cos 2\beta)(-i+\cos 2\beta) = 125.8294575\ GeV \simeq m_h$
14. $\upsilon \cdot \cos\beta + (\upsilon \cdot \cos\beta)/(2 \cdot SU(4)) = VH + m_h - \left[\left(\sum_{l=1}^{6} m_l^2 \right) + \left(\sum_{q=1}^{6} m_q^2 \right) + m_{W^\pm} + m_Z + m_a \right]$
15. $\upsilon \cdot \cos\beta + (\upsilon \cdot \cos\beta)/(2 \cdot SU(4)) = 2 \cdot m_e \cdot \left(\sum_{n=1}^{16} n \right)$
16. $\left(2 \cdot m_e/\alpha^2\right) \simeq (\upsilon \cdot \cos\beta)/\cos^2 2\beta$
17. $\left(\sum_{l=1}^{6} m_l^2 \right) + \left(\sum_{q=1}^{6} m_q^2 \right) + m_{W^\pm} + m_Z + m_h + m_a = VH + \ \upsilon/\left(2 \cdot \ln(m_{PK}/m_e) \cdot \alpha\right)\ ;\ m_{PK} =$ Planck mass
18. $6q + 6l + 1W + 1Z + 1h + 1a = 4^2$
19. $6q + 6l + 1W + 1Z + 1h + 1a + 8g + 1\gamma + 1G = 26$
20. $(26 - \cos(2\pi/15))/240 = \cos\beta = (26 - \cos(2\pi/15))/2 \cdot \left(\sum_{n=1}^{15} n \right)$
21. $26/16 = 1 + \cos^2\theta_W(GUT)$
22. $16/26 \simeq (m_h/VH) + \cos\beta = (125.8013/246.2196509) + \cos 84^{\circ} = 0.6154596564$
23. $3c \cdot 6q + 6l + 1W + 1Z + 1h + 1a + 8g + 1\gamma + 1G = 38 = SU(6) + SU(2)\ ;\ SU(6) - SU(2) = 2 \cdot 4^2 = 2^5$
24. $2 \cdot \left(\left(\sum_{l=1}^{6} m_l \right) + \left(\sum_{q=1}^{6} m_q \right) + \left(\sum_{B=1}^{3} m_B \right) + m_a \right) \Big/ - 38 \cdot \cos\beta \cdot \cos 2\beta \simeq VH$
25. $m_h/\left(2 \cdot 38 \cdot \cos^2 2\beta\right) = 1.73\ GeV = G_g(0)$ (ground state glueball)
26. $3c \cdot 6q + 6l + 1W + 1Z + 1h + 1a = 28 = SO(8)$
27. $8g + 1\gamma + 1G = 10$
28. $28 \cdot m_h/10 \simeq \left(\sum_{l=1}^{6} m_l \right) + \left(\sum_{q=1}^{6} m_q \right) + \left(\sum_{B=1}^{3} m_B \right) + m_a - m_h$

29. $(VH \cdot 31/16) + \left(\sum_{l=1}^{6} m_l \right) \cdot \sin^2 \beta = \left(\sum_{l=1}^{6} m_l \right) + \left(\sum_{q=1}^{6} m_q \right) + \left(\sum_{B=1}^{3} m_B \right) + m_a$
30. $(VH)^2 \cdot \cos\beta / (\sin\beta + \cos\beta - 1)^2 \cdot 10^2 = m_W^2 \quad ; \quad (246.2196509\ GeV)^2 \cdot \cos 84^{\circ} / \left(\sin 84^{\circ} + \cos 84^{\circ} - 1\right)^2 \cdot 10^2 = (80.368144\ GeV)^2$
31. $240 \cdot \sin\beta/(2\pi) \simeq 38$

4.3 The Parameter μ Of The Supersymmetry.

1. $VH/\left(1 + \sin(2\pi/15)\right) = VH/\left(\sin 2\beta - \cos 2\beta\right)^2 = \upsilon$
2. $\upsilon^2 + m_Z^2/2 = \mu^2$; $\mu = 186.5280833\ GeV$

4.3.1 Parameter μ : Remarkable Properties.

- $(VH \cdot \cos(2\pi/15))^2 = \mu^2 + m_h^2$
- $2\mu \simeq VH + m_h$
- $\left(VH \cdot 5^2\right)/33 = \mu$
- $\mu/\left(10 \cdot \ln\left(\mu^2/m_t^2\right)\right) = m_h$
- $\ln\left(\mu^2/m_h^2\right) + 1 = 2 \cdot \sin^2\left(2\pi/R_\gamma\right)$; $R_\gamma = \sqrt{\alpha^{-1}/4\pi}$

4.4 The β Anngle and the Constants of Electromagnetic and Strong Coupling to the Z Boson Scale.

3. $\frac{240 \cdot \alpha - \sin\beta + \cos\beta + 1}{240} - \frac{m_e}{2 \cdot (m_W + m_Z)} = \alpha(M_Z) = (128.9619681)^{-1}$
4. $1 - \left(m_W^2/m_Z^2\right) - \cos\beta = \alpha_s(M_Z) = 0.1183880937$

5 The Maximum Branching Ratio Of Higgs Boson Decay: Pairs Of b Quarks.

5. $m_h/2 \cdot SU(4) = m_h/2 \cdot 15 = m_b = 125.8013\ GeV/30 = 4.1933\ GeV$
6. $max\ B\,(h \to bb) = \frac{6q+6l+1W+1Z+1h+1a-1h=4^2-1}{6q+6l+1W+1Z+1h+1a+8g+1\gamma+1G=26} = \frac{15}{26} = 0.5769230769 \simeq \sin\beta + \cos\beta - \frac{1}{\cos^4 2\beta + 1} = 0.57697003$
7. $max\ B\,(h \to bb) \simeq \cos\theta_{s=1/2} - \alpha^2(M_Z) = \frac{1/2}{\sqrt{(\frac{1}{2}+1)\frac{1}{2}}} - \alpha^2(M_Z) = \left(0.5/\sqrt{0.75}\right) - (128.962)^{-2} = 0.5772901412$
8. $max\ B\,(h \to bb) \simeq 1/240 \cdot \alpha \cdot \sin^2\beta = 0.5772909258$

6 The Stop Quark Mass.

After determining the β angle; we can calculate quite accurately the stop quark mass using equation NMSSM model with a loop of correction.

With the parameters $\lambda = (10/15)$ and $\kappa = 1$ ($m_h = 125.8013\ GeV$; $\beta = 84^{\circ}$)

9. $m_h^2 \simeq m_Z^2 \cos^2 2\beta - \frac{\lambda^2}{\kappa^2}\left(\lambda - \kappa \sin 2\beta\right)^2 + \frac{3m_t^4}{4\pi^2 \upsilon^2} \cdot \ln\left(\frac{m_{\tilde{t}1} \cdot m_{\tilde{t}2}}{m_t^2}\right)$
10. $m_h^2 - m_Z^2 \cos^2 2\beta + \frac{\lambda^2}{\kappa^2}\left(\lambda - \kappa \sin 2\beta\right)^2 \simeq \frac{3m_t^4}{4\pi^2 \upsilon^2} \cdot \ln\left(\frac{m_{\tilde{t}1} \cdot m_{\tilde{t}2}}{m_t^2}\right)$
11. $m_{\tilde{t}1,\tilde{t}2} \simeq 1916\ GeV$
12. $4 \cdot \left(\left(\sum_{l=1}^{6} m_l\right) + \left(\sum_{q=1}^{6} m_q\right) + \left(\sum_{B=1}^{3} m_B\right) + m_a\right) = 1915.66\ GeV$
13. $m_h/\lambda \cdot [(\sin\beta + \cos\beta - 1) \cdot \sin\beta] = 1915.605\ GeV \simeq m_{\tilde{t}1,\tilde{t}2}$

7 Theoretical Proposal For The Axion Mass.

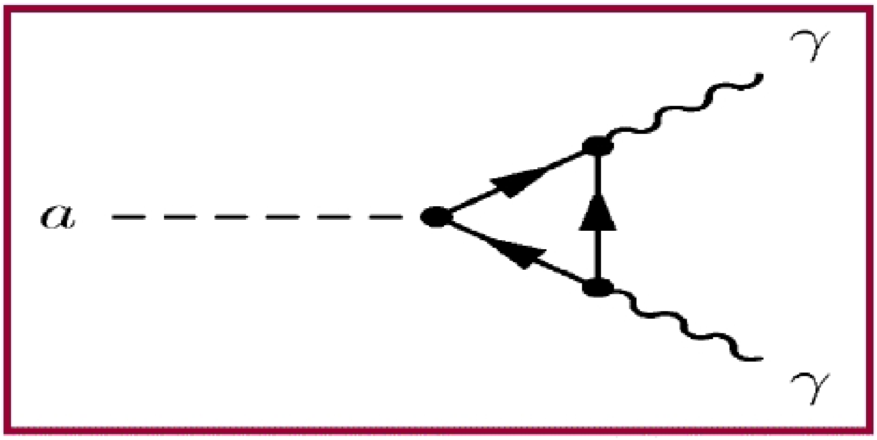
To calculate the mass of the axion, depart of the effect of the decay of axions into photons and backwards, produced by intense electromagnetic fields.

With an axion decaying into two photons, one must consider all possible combinations of the vacuum. Being the vacuum compound, 240, particle-antiparticle pairs; the two photons produced by the axion can become a particle-antiparticle pair. Therefore a matrix of 240 x 240 will have.

Recalling the results of our previous work, in particular the calculation of the baryon density:

14. $\Omega_b = \left(2 \cdot \ln(m_{PK}/m_e) + \alpha^{-1} - 240\right)/2$; $240 = 2 \cdot \sum_{n=1}^{15} n$
15. $x^2 + x - 240 = 0$; $x_1 = 15$; $x_2 = -16$
16. $x^2 - x - 240 = 0$; $x_3 = -15$; $x_4 = 16$

The coupling to the electromagnetic field is determined by the fine structure constant to zero momentum. As the description of the virtual vacuum; electrons are particles that generate the electromagnetic field, so that the reference mass to calculate the mass of the axion be the electron. The coupling of the electroweak force by the W bosons and Z will add a dependent factor, the effective sinus Weinberg angle.



Axion mass is defined by the following equivalent equations:

17. $m_a = m_e \alpha^2 \sin^2_{eff} \theta_W / 240^2$

18. $m_a = m_e \alpha^2 (M_Z) \cdot z^2 / 240^2$; $z = \frac{\sqrt{m_u/m_d}}{1+(m_u/m_d)}$

19. $m_a = m_{PK} \cdot \sin^{120}(2\pi/11) \cdot \left(1 + \frac{\cos^4 2\beta}{11^2}\right)$

20. $\left(10 \cdot \cos^4 2\beta\right)^{15} \cdot \left(m_e \alpha^2/240^2\right) \cdot \left(1 + \alpha \sin^2(2\pi/10)\ \right) = m_h$

21. $m_a \simeq 110\ \mu\ eV$

7.1 The Casimir effect and axion.

22. $F_c/A = \hbar c \pi^2 / 240 \cdot d^4 \rightarrow F_c \cdot d^4 / A \cdot \hbar c = \pi^2/240$

23. $m_e \cdot \ln^2 \varphi \cdot \alpha^2/240^2 = m_a \rightarrow (m_a/m_e) = \ln^2 \varphi \cdot \alpha^2/240^2$

24. $\left[F_c \cdot d^4/A \cdot \hbar c\right] / (m_a/m_e) = \left(\pi^2/240\right) / \left(\ln^2 \varphi \cdot \alpha^2/240^2\right) = [2 \cdot P(2, R_\gamma)]^{240} / \sin\beta$

25. $P(2, R_\gamma) = 2 \cdot \sin^2(2\pi/R_\gamma)/R_\gamma$; $R_\gamma = (\alpha 4\pi)^{-1/2}$

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