Journal of Modern Physics, 2018, 9, 2638-2656
http://www.scirp.org/journal/jmp
ISSN Online: 2153-120X
ISSN Print: 2153-1196

Pseudoscalar Top-Bottom Quark-Antiquark Composite as the Resonance with 28 GeV at the LHC: Hadron Masses and Higgs Boson Masses Based on the Periodic Table of Elementary Particles

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How to cite this paper: Chung, D.-Y. (2018) Pseudoscalar Top-Bottom Quark-Antiquark Composite as the Resonance with 28 GeV at the LHC: Hadron Masses and Higgs Boson Masses Based on the Periodic Table of Elementary Particles. *Journal of Modern Physics*, **9**, 2638-2656.
https://doi.org/10.4236/jmp.2018.914164

Received: December 1, 2018
Accepted: December 25, 2018
Published: December 28, 2018

Abstract

This paper posits that the observed resonance with 28 GeV at the LHC is the pseudoscalar top-bottom quark-antiquark composite which has the calculated mass of 27.9 GeV derived from the periodic table of elementary particles. The calculated mass is for the mass of $b\bar{b}$ + ($b\bar{b}$ + $t\bar{t}$)/2. In the periodic table of elementary particles, t quark (13.2 GeV) in the pseudoscalar top-bottom quark-antiquark composite is only a part of full t quark (175.4 GeV), so pseudoscalar $t\bar{t}$ (26.4 GeV) cannot exist independently, and can exist only in the top-bottom quark-antiquark composite. As shown in the observation at the LHC, the resonance with 28 GeV weakens significantly at the higher energy collision (13 TeV), because at the higher collision energy, low-mass pseudoscalar $t\bar{t}$ in the composite likely becomes independent full high-mass vector $t\bar{t}$ moving out of the composite. The periodic table of elementary particles is based on the seven mass dimensional orbitals derived from the seven extra dimensions of 11 spacetime dimensional membrane. The calculated masses of hadrons are in excellent agreement with the observed masses of hadrons by using only five known constants. For examples, the calculated masses of proton, neutron, pion ($\pi^{\pm}$), and pion (π^{0}) are 938.261, 939.425, 139.540, and 134.982 MeV in excellent agreement with the observed 938.272, 939.565, 139.570, and 134.977MeV, respectively with 0.0006%, 0.01%, 0.02%, and 0.004%, respectively for the difference between the calculated and observed mass. The calculated masses of the Higgs bosons as the intermediate vector boson composites are in excellent agreements with the observed masses. In conclusion, the calculated masses of the top-bottom quark-antiquark composite (27.9 GeV), hadrons, and the Higgs bosons by the periodic table of elementary particles are in excellent agreement with the observed masses of resonance with 28 GeV at the LHC, hadrons, and the Higgs bosons, respectively.

Keywords

LHC, CMS, Resonance, b Quark Jet, Periodic Table of Elementary Particles, Top Quark, Bottom Quark, Hadron Masses, Mass Calculation, Higgs Boson

1. Introduction

In the search for resonances in the mass range 12 - 70 GeV produced in association with a b quark jet and a second jet, and decaying to a muon pair, the CMS Collaboration at the LHC recently reported an excess of events above the background near a dimuon mass of 28 GeV [1]. The search is carried out in two mutually exclusive event categories from proton-proton collisions at center-of-mass energies of 8 and 13 TeV. The first category involves a b quark jet in the central region and at least one jet in the forward region, while the second category involves two jets in the central region, at least one of which is identified as a b quark jet, no jets in the forward region. At the 8 TeV collision, the first category has 4.2 standard deviations, while the second category has 2.9 standard deviations. At the 13 TeV collision, the first category has 2.0 standard deviations, while the second category results in a 1.4 standard deviation deficit.

This potential new particle at 28 GeV does not match the properties of any of particles in the standard model. It is also puzzling that the resonance at 28 GeV weakens, disappears, or gets inverted at 13 TeV. This paper posits that the resonance with 28 GeV observed recently at the LHC is the pseudoscalar top-bottom quark-antiquark composite which has the calculated mass of 27.9 GeV derived from the periodic table of elementary particles in good agreement with the observed 28 GeV. The calculated mass is the mass of three pseudoscalar b quarks and one pseudoscalar t quark which represent the composite of $b_p\bar{b}_p$ + ($b_p\bar{b}_p$ + $t_p\bar{t}_p$)/2 where p = pseudoscalar. (The quark in pseudoscalar meson is denoted as "pseudoscalar quark", while the quark in vector mesons is denoted as "vector quarks" which has higher mass than pseudoscalar quark.) As described in the periodic table of elementary particles, pseudoscalar t quark (13.2 GeV) is only a part of full t quark (175.4 GeV), so pseudoscalar $t_p\bar{t}_p$ (26.4 GeV) cannot exist independently, and can exist only in the top-bottom quark-antiquark composite. As shown in the observation at the LHC, the resonance with 28 GeV weakens significantly at the higher energy collision (13 TeV), because at the higher collision energy, low-mass pseudoscalar $t\bar{t}$ in the composite likely becomes independent full high-mass vector $t\bar{t}$ moving out of the composite. To account for the observed two jets, the composite has two jets consisting of a $b\bar{b}$ jet and a b + t jet, where $b\bar{b}$ jet for ($b_p\bar{b}_p$ + $t_p\bar{t}_p$)/2 is more stable than b + t jet which decays faster into the jet in the forward region to constitute the first category of the search by the CMS Collaboration at the LHC.

The periodic table of elementary particles is based on the seven mass dimensional orbitals derived from the seven extra dimensions of 11 spacetime dimensional membrane particles [2] [3] [4]. The seven mass dimensional orbitals include the seven principal mass dimensional orbitals for stable baryonic matter leptons (electron and neutrinos), gauge bosons, gravity, and dark matter and the seven auxiliary mass dimensional orbitals for unstable leptons (muon and tau) and quarks, and calculate accurately the masses of all elementary particles and the cosmic rays by using only five known constants [5] [6]. Hadron masses can be calculated in excellent agreement with the observed masses of hadrons. For examples, the calculated masses of proton, neutron, pion ($\pi^{\pm}$), and pion (π^0) are 938.261, 939.425, 139.540, and 134.982 MeV in excellent agreement with the observed 938.272, 939.565, 139.570, and 134.977 MeV, respectively with 0.0006%, 0.01%, 0.02%, and 0.004%, respectively for the difference between the calculated and observed mass.

Section 2 describes the periodic table of elementary particles and the mass formulas. Section 3 deals with quarks and hadrons. Section 4 explains the top-bottom quark-anti-quark composite as the resonance at 28 GeV. Section 5 describes the Higgs boson doublet as the intermediate vector boson composites.

2. The Periodic Table of Elementary Particles and the Mass Formulas

The periodic table of elementary particles [2] [3] [4] is based on the seven mass dimensional orbitals derived from the seven extra dimensions of 11 spacetime dimensional membrane. The seven mass dimensional orbitals include the seven principal mass dimensional orbitals for stable baryonic matter leptons (electron and neutrinos), gauge bosons (all forces), gravity, and dark matter (five sterile dark matter neutrinos) and the seven auxiliary mass dimensional orbitals for unstable leptons (muon and tau) and quarks (d, u, s, c, b, and t) as in **Figure 1** and **Table 1**.

Table 1. The periodic table of elementary particles for baryonic matter and dark matter.

d	a = 0	a = 0	1	2	1	2	3	4	5	a = 0
	Stable Baryonic Matter Leptons	Dark Matter Leptons	Unstable Leptons		Quarks					Bosons
5	ν_e	ν_{DM5}								B_5 = A electromagnetism
6	e	ν_{DM6}								B_6 = g* strong (basic gluon)
7	ν_μ	ν_{DM7}	μ_7	τ_7	d_7/u_7	s_7	c_7	b_7	t_7	B_7 = Z_L^0 left-handed weak
8	ν_τ	ν_{DM8}	μ_8 (absent)		b_8 (absent)	t_8				B_8 = X_R right-handed CP
9	ν'_τ (high-mass ν_τ)	ν_{DM9}								B_9 = X_L left-handed CP
10										B_{10} = Z_R^0 right-handed weak
11										B_{11} = gravity

d = principal mass dimensional orbital number, a = auxiliary mass dimensional orbital number.

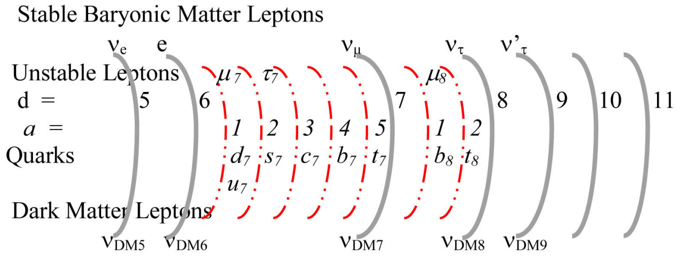

Figure 1. The seven principal mass dimensional orbitals (solid lines) denoted by the principal mass dimensional orbital number d and the seven auxiliary mass dimensional orbitals (dash-dotted lines) denoted by the auxiliary mass dimensional orbital number *a*.

The periodic table of elementary particles calculates accurately the particle masses of all leptons, quarks, gauge bosons, the Higgs boson, and the cosmic rays by using only five known constants: the number (seven) of the extra spatial dimensions in the observed four-dimensional spacetime from the eleven-dimensional membrane, the mass of electron, the masses of Z and W bosons, and the fine structure constant [5] [6]. The calculated masses are in excellent agreements with the observed masses. For examples, the calculated masses of muon, top quark, pion, neutron, and the standard model Higgs boson are 105.55 MeV, 175.4 GeV, 139.54 MeV, 939.42 MeV, and 126 GeV, respectively, in excellent agreements with the observed 105.65 MeV, 172.4 GeV, 139.57 MeV, 939.27 MeV, and 126 GeV, respectively.

The seven mass dimensional orbitals are arranged as F_5 B_5 F_6 B_6 F_7 B_7 F_8 B_8 F_9 B_9 F_{10} B_{10} F_{11} B_{11}, where F_d and B_d are mass dimensional fermion and mass dimensional boson, respectively. As described in the previous papers [2] [3], the mass of mass dimensional fermion and the mass of mass dimensional boson are related to each other with three simple formulas as the follows.

$$M_{d,B} = M_{d,F} / \alpha_d \tag{1}$$

$$M_{d+1,F} = M_{d,B} / \alpha_{d+1} \tag{2}$$

$$M_{d+1,B} = M_{d,B} / \alpha_{d+1}^2 \tag{3}$$

where d is the mass dimensional orbital number, F is fermion, and B is boson. Each dimension has its own α_d, and all α_d's except α_7 (α_w) of the seventh dimension (weak interaction) are equal to α, the fine structure constant of electromagnetism. The given observed masses are the mass of electron for F_6 and the mass of Z boson for B_7. From Equations (1) and (3), $\alpha_w = \alpha_7 = \alpha$ of week interaction = $(M_{B6}/M_{B7})^{1/2} = (M_{F6}/\alpha/M_{B7})^{1/2} = (M_e/\alpha/M_Z)^{1/2} = 0.02771$. Therefore, the masses of gauge bosons are as in Table 2.

The lowest energy gauge boson (B_5) at d = 5 is the Coulomb field for electromagnetism. The second gauge lowest boson (B_6) at d = 6 is basic gluon (g* = 70 MeV ≈ one half of pion) is the strong force as the nuclear force in the pion theory [7] where pions mediate the strong interaction at long enough distances (longer than the nucleon radius) or low enough energies. At short enough distances (shorter than the nucleon radius) or high enough energies, gluons emerge

Table 2. The masses of the principal mass dimensional orbitals (gauge bosons).

B_d	M_d	GeV (calculated)	Gauge boson	Interaction
B_5	$M_e\alpha$	3.7×10^{-6}	A = photon	Electromagnetic
B_6	M_e/α	7×10^{-2} (70.02 MeV)	g* = basic gluon	Strong
B_7	$M_Z = M_{B6}/\alpha_w^2$	91.1876 (given)	Z_L^0	weak (left)
B_8	$M_7/\alpha^2 = M_Z/\alpha^2$	1.71×10^6	X_R	CP (right) nonconservation
B_9	$M_8/\alpha^2 = M_Z/\alpha^4$	3.22×10^{10}	X_L	CP (left) nonconservation
B_{10}	$M_9/\alpha^2 = M_Z/\alpha^6$	6.04×10^{14}	Z_R^0	weak (right)
B_{11}	$M_{10}/\alpha^2 = M_Z/\alpha^8$	1.13×10^{19}	G	Gravity

to confine fractional charge quarks. B_6 is denoted as basic gluon, g*. The third lowest boson (B_7) at d = 7 is Z^0 for the weak interaction.

F_{11} (8.275×10^{16} GeV) relates to spin 3/2 gravitino, while B_{11} (1.134×10^{19} GeV) relates to spin 2 graviton. In supersymmetry, gravitino and graviton mediate the supersymmetry between fermion and boson in space dimension and gravitation. There are 10 space dimensions in the 11 spacetime dimensional membrane. As a result, the supersymmetry involves $10F_{11} + B_{11}$, which is equal to 1.217×10^{19} GeV in excellent agreement with the Planck mass (1.221×10^{19} GeV) derived from observed gravity as $(\hbar c/G)^{1/2}$ where c is the speed of light, G is the gravitational constant, and ħ is the reduced Planck constant.

The lepton mass formula and the quark mass formula are derived from the incorporation of basic gluon (g* = B_6 = 70 MeV) to electron. The incorporation of basic gluon as flux quanta follows the the composite fermion theory for the FQHE (fractional quantum Hall effect) [8] [9]. In the composite fermion model for FQHE, the formation of composite fermion is through the attachment of an even number of magnetic flux quanta to electron, while the formation of composite boson is through the attachment of an odd number of magnetic flux quanta to electron. In the same way, the formation of composite fermion is through the attachment of an even number of basic gluons to electron, while the formation of composite boson is through the attachment of an odd number of basic gluons to electron. The formation of composite boson is equal to the formation of composite di-leptons, so the formation of composite lepton is through the attachment of one half of an odd number of basic gluons to electron. As a result, the muon (μ) mass formula is as follows.

$$\begin{aligned} M_{\mu_7} &= Me + 3M_{g*}/2 \\ &= Me + 3M_e/2\alpha \\ &= 105.5488 \text{ MeV} \end{aligned} \tag{4}$$

which is in excellent agreement with the observed 105.6584 MeV [10] for the mass of muon. The mass of τ follows the Barut lepton mass formula [11] as follows.

$$M_{\text{lepton}} = M_e + \frac{3M_e}{2\alpha} \sum_{a=0}^{n} a^4 \tag{5}$$

where a = 0, 1, and 2 are for e, μ_7, and τ_7, respectively. The calculated mass of τ_7 is 1786.2 MeV in good agreement with the observed mass as 1776.82 MeV. According to Barut, the second term, $\sum_{a=0}^{n} a^4$ of the mass formula is for the Bohr-Sommerfeld quantization for a charge-dipole interaction in a circular orbit. The more precise calculated mass of τfor the tau lepton mass formula is as follows.

$$\begin{aligned} M_\tau &= Me + \left(\frac{3M_e}{2\alpha} - M_e\right) \sum 2^4 \\ &= Me + \left(17\frac{3M_e}{2\alpha} - 17M_e\right) \\ &= 1777.47 \text{ MeV} \end{aligned} \tag{6}$$

which is in excellent agreement with observed 1776.82 MeV, and means that during this dipole-interaction in a circular orbit for τ, an electron with total mass of $17M_e$ is lost. $17M_e$ is shown as the observed 17 MeV for $34M_e$ in the light boson (17 $e\bar{e}$) [12] [13].

Quark has fractional charge (±1/3 or ±2/3), 3-color gluons (red, green, and blue) for 3g*, and both the principal mass dimensional orbitals and axillary mass dimensional orbitals, so similar to Equation (4), d and u in the principal mass dimensional orbital involves e/3 or 2e/3 and 3g* as follows.

principal mass dimensional orbital at d = 6

$$\begin{aligned} M_{\text{principal } q} &= \frac{1 \text{ or } 2Me}{3} + \frac{3(3M_{g*})}{2} \\ &= \frac{1 \text{ or } 2Me}{3} + \frac{3(3M_{B6})}{2} \\ &= \frac{1 \text{ or } 2Me}{3} + \frac{9Me}{2\alpha} \end{aligned} \tag{7}$$

For quarks in the auxiliary mass dimensional orbitals, 3-color basic gluons (3g*) become 3-color auxiliary basic gluons ($3g^*_{a7}$) at d = 7. Based on Equation (2), auxiliary basic gluon is derived from muon as follows.

$$M_{3g^*_{a7}} = M_{\mu_7} \alpha_w \tag{8}$$

Similar to Equation (5), the masses of quarks in the auxiliary mass dimensional orbital are as follows.

auxiliary mass dimensional orbital at d = 7

$$M_{\text{auxiliary } q7} = \frac{3\left(3M_{g^*_{a7}}\right)}{2} \sum_{a=1}^{n} a^4 = \frac{9M_{\mu_7}\alpha_w}{2} \sum_{a=1}^{n} a^4 \tag{9}$$

The quark mass formula at d = 7 is the combination of Equations (7) and (9) as follows.

$$M_{q7} = \frac{1 \text{ or } 2Me}{3} + \frac{9Me}{2\alpha} + \frac{9M_{\mu_7}\alpha_w}{2} \sum_{a=1}^{n} a^4 \tag{10}$$

where a = 1, 2, 3, 4, and 5 for u_7/d_7, s_7, c_7, b_7, and t_7, respectively.

The quark mass at a = 5 for the auxiliary mass dimensional orbital at d = 7 is the maximum mass below the mass of B_7, so the next auxiliary mass dimensional orbital has to start from B_7.There are b and t at d = 8, so it is necessary to have $\mu_8$for the masses of b and t. Like μ_7 in Equation (4), the mass of μ_8 is as follows.

$$\begin{aligned} M_{\mu_8^0} &= 2Me + 3M_{g_7^*}/2 \\ &= 2Me + 3M_{B_7}/2 \\ &= 2Me + 3M_{Z^0}/2 \\ &= 136.78 \text{ GeV} \end{aligned} \tag{11}$$

Since at d = 7, there are 3-color basic gluons, at d = 8, 3-*color* basic gluons are not needed, and only one basic gluon (g_7^*) at d = 7 is used. Similar to Equations (7) and (9). The quark mass formulas for the principal and auxiliary mass dimensional orbitals are as follows.

$$\begin{gathered} \text{principal mass dimensional orbital at d} = 7 \\ M_{\text{principal quark}} = 3M_{g_7^*}/2 = 3M_{B_7}/2 = 3M_Z/2 \end{gathered} \tag{12}$$

$$\begin{gathered} \text{auxiliary mass dimensional orbital at d} = 8 \\ M_{\text{auxiliary quark}} = \frac{3\left(M_{g_{a8}^*}\right)}{2}\sum_{a'=1}^{n'} a'^4 = \frac{3\mu_8^0\alpha}{2}\sum_{a'=1}^{n'} a'^4 \end{gathered} \tag{13}$$

The quark mass formula at d = 8 is the combination of Equations (12) and (13) as follows.

$$M_{q8} = \frac{3M_Z}{2} + \frac{3M_{\mu_8^0}\alpha}{2}\sum_{a'=1}^{n'} a'^4 \tag{14}$$

where a'= 1 and 2 for b_8 and t_8, respectively.

Combining Equations (10) and (14), the quark mass formula is as follows.

$$M_{\text{quark}} = \frac{1 \text{ or } 2Me}{3} + \frac{9Me}{2\alpha} + \frac{9M_{\mu_7}\alpha_w}{2}\sum_{a=1}^{n} a^4 + \frac{3M_Z}{2} + \frac{3M_{\mu_8^0}\alpha}{2}\sum_{a'=1}^{n'} a'^4 \tag{15}$$

where a =1, 2, 3, 4, and 5 for d/u. s, c, b, and t, respectively, and a'= 1 and 2 for b and t respectively. The calculated masses for d, u, s, c, b, and t are 328.4 MeV, 328.6 MeV, 539 MeV, 1605.3 MeV, 4974.6 MeV, and 175.4 GeV, respectively. In the standard model, there are three generations of leptons. Extra-muon μ_8 is outside of the three generations of leptons in the standard model, so μ_8 is absent as shown in Table 2. As shown in Table 2, to be symmetrical to the absent μ_8, b_8 quark is also absent. The calculated mass of top quark is 175.4 GeV in good agreement with the observed 172.4 GeV. The calculated masses are comparable to the quark masses proposed by De Rujula, Georgi, and Glashow [14], Griffiths [15], and El Naschie [16].

3. Quarks and Hadrons

For baryons, the quarks in the periodic table of elementary particles are baryonic quarks. Mesons have vector mesons with parallel spins and pseudoscalar mesons with antiparallel spins. Since parallel spins have higher energy than antiparallel spins, vector mesons have higher masses than pseudoscalar mesons. For higher-mass vector mesons (parallel spins), vector t, b, c, and s are baryonic t, b, c, s, and vector d and u are baryonic d and u plus basic gluon (g* = 70 MeV). For lower-mass pseudoscalar mesons (antiparallel spins), pseudoscalar t as t_7 is a part of vector t (= $t_7 + t_8$), pseudoscalar b and c are vector quarks minus g*, and pseudoscalar d, u, and s are derived from g* as shown in **Table 3**.

The calculated masses and the observed masses [10] of baryons are listed in **Table 4**. The binding energy for each d or u quark involves the auxiliary mass dimensional orbital at d = 7 from Equation (9). The primary binding energy E_{Q1} for d or u quark from Equation (9) is as follows.

$$E_{Q1} = 9M_{\mu_7}\alpha_w/2 = 13.162\ \text{MeV} \tag{16}$$

Table 3. The masses of quarks.

Particle	Symbol	Composition	d=	a=	Charge	Generation	Mass (calculated)
Electron	e	e	6	0	−1	1	0.511 MeV (given)
Basic gluon	g*	B_6	6	0	0		70.02 MeV
Baryon							
d	d_b	d_7	7	1	−1/3	1	328.5 MeV
u	u_b	u_7	7	1	2/3	1	328.6 MeV
s	s_b	s_7	7	2	−1/3	2	539.0 MeV
c	c_b	c_7	7	3	2/3	2	1605.3 MeV
b	b_b	b_7	7	4	−1/3	3	4974.7 MeV
t	t_b	$t_7 + t_8$	7 + 8	5 + 2	2/3	3	175.4 GeV
Vector meson							
d	d_v	d_7 + g*	6 + 7	0 + 1	−1/3	1	398.5 MeV
u	u_v	u_7 + g*	6 + 7	0 + 1	2/3	1	398.6 MeV
s	s_v	s_7	7	2	−1/3	2	539.0 MeV
c	c_v	c_7	7	3	2/3	2	1605.3 MeV
b	b_v	b_7	7	4	−1/3	3	4974.7 MeV
t	t_v	$t_7 + t_8$	7 + 8	5 + 2	2/3	3	175.4 GeV
Pseudoscalar meson							
d	d_p	g* + 1/3e	6	0	−1/3	1	70.2 MeV
u	u_p	g* + 2/3e	6	0	2/3	1	70.4 MeV
s	s_p	2(3g* + 3e) + 1/3e	6	0	−1/3	2	423.4 MeV
c	c_p	c_7 − g*	6 + 7	0 + 3	2/3	2	1535.3 MeV
b	b_p	b_7 − g*	6 + 7	0 + 4	−1/3	3	4904.7 MeV
t	t_p	t_7	7	5	2/3	3	13.2 GeV

d = principal mass dimensional mass orbital number, a = auxiliary mass dimensional number, generation = generation of lepton-quark in the standard model.

Table 4. The masses of baryons.

Baryon	Composition	Calculated mass without binding energy MeV	Calculated mass with binding energy MeV	Observed mass MeV	% difference
proton (P)	$u_bu_bd_b$	985.679	938.261	938.272	−0.0006
neutron (N)	$u_bd_bd_b$	985.508	939.425	939.565	−0.01
Lambda (Λ^0)	$u_bd_bs_b - g^*$	1126.1	1117.7	1115.7	0.18
Sigma (Σ^0)	$u_bd_bs_b$	1196.1		1192.6	0.29
charmed Lambda (Λ_c^+)	$u_bd_bc_b + g^*$	2332.4	2286.3	2286.5	0.005
charmed Sigma (Σ_c^+)	$u_bd_bc_b + 3g^*$	2472.5	2449.4	2452.9	−0.14
bottom Lambda (Λ_b^+)	$u_bd_bb_b$	5631.7	5608.7	5619.4	−0.19
Sigma (Σ^+)	$u_bu_bs_b$	1196.3	1187.9	1189.4	−0.13
Sigma ($\Sigma-$)	$d_bd_bs_b$	1195.9		1197.4	−0.13
charmed Sigma (Σ_c^{++})	$u_bu_bc_b + 3g^*$	2472.7	2449.6	2453.7	−0.18
charmed Sigma (Σ_c^0)	$d_bd_bc_b + 3g^*$	2472.3	2449.4	2453.7	−0.14
bottom Sigma (Σ_b^+)	$u_bu_bb_b + 3g^*$	5842.0	5818.9	5811.3	0.13
bottom Sigma (Σ_b^-)	$d_bd_bb_b + 3g^*$	5841.6	5818.6	5815.5	0.05
Xi (Ξ^0)	$u_bs_bs_b - g^*$	1336.7	1313.6	1319.9	0.38
Xi (Ξ^-)	$d_bs_bs_b - g^*$	1336.5	1328.1	1319.7	−0.15
charmed Xi (Ξ_c^+)	$u_bs_bc_b$	2473.0	2464.6	2467.8	−0.13
charmed Xi (Ξ_c^+)	$d_bs_bc_b$	2472.8		2470.9	0.08
charmed Xi prime ($\Xi_c^{+\prime}$)	$u_bs_bc_b + 2g^*$	2612.9	2581.6	2575.6	0.23
charmed Xi prime ($\Xi_c^{+\prime}$)	$d_bs_bc_b + 2g^*$	2612.9	2581.4	2577.9	0.14
double charmed Xi ($\Xi_c^{++\prime}$)	$u_bc_bc_b + 2g^*$	3679.3	3633.3	3621.4	0.33
bottom Xi (Ξ_b^+)	$u_bs_bb_b$	5842.3	5810.9	5787.8	0.40
bottom Xi (Ξ_b^+)	$d_bs_bb_b$	5842.2	5810.7	5791.1	0.34
charmed Omega (Ω_c^0)	$s_bs_bc_b$	2683.4		2695.2	−0.44
bottom Omega (Ω_b^0)	$s_bs_bb_b$	6052.8		6071	−0.30

The secondary binding energy E_{Q2} for d or u quark is as follows.

$$E_{Q2} = 9E_{Q1}\alpha_w/2 = 1.641 \text{ MeV} \tag{17}$$

The tertiary binding energy E_{Q3} for d or u quark bond is as follows.

$$E_{Q3 \text{ for quark}} = 9E_{Q2}\alpha_w/2 = 0.205 \text{ MeV} \tag{18}$$

The binding energy E_{QQ} for each dd, uu, and du bond is $2E_Q$.

$$E_{QQ} = 2E_Q \tag{19}$$

The mass of neutron (ddu) involves the mass of 2d and u subtracting the binding energy of E_{QQ1} and E_{QQ2} for two quark bonds (2du's) as follows.

$$M_N = Mu + 2Md - 2E_{QQ_{d/u}1} + 2E_{QQ_{d/u}2} = 939.425 \text{ MeV} \quad (20)$$

The calculated mass of neutron is in excellent agreement with the observed value 939.565 MeV with the % mass difference between the calculated and the observed masses = −0.01%.

Proton (duu) is more stable than neutron, so it involves the additional binding energy from the tertiary binding energy E_{QQ3}. For the mass of proton, the baryon number conservation involves the loss of the mass of positron to prevent the decay into positron. Proton becomes permanently stable. The proton mass formula is as follows.

$$M_P = 2Mu + Md - 2E_{QQ_{d/u}1} + 2E_{QQ_{d/u}2} - 2E_{QQ_{d/u}3} - Me = 938.261 \text{ MeV} \quad (21)$$

The calculated mass of proton is in excellent agreement with the observed value 938.272 MeV with the % mass difference between the calculated and the observed masses = −0.0006%.

Being less stable than du bond, the primary binding energy for us bond is one-third of the primary binding energy for du as follows.

$$E_{Q1} = 3M_{\mu_7}\alpha_w/2 = 4.387 \text{ MeV} \quad (22)$$

The secondary binding energy E_{Q2} for u and s is as follows.

$$E_{Q2} = 3E_{Q1}\alpha_w/2 = 0.182 \text{ MeV} \quad (23)$$

Only one bond (with binding energy) or less per baryon is allowed for the baryons with s, c, and b. The mass of Sigma (Σ^+) as uus is as follows.

$$M_N = 2Mu + 2Ms - E_{QQ_{us}1} + E_{QQ_{us}2} = 1187.9 \text{ MeV} \quad (24)$$

which is in excellent agreement with the observed value 1189.4 MeV. The binding energy of ds is zero. For example, Sigma (Σ−) with dds has the mass of d + s + d which is 1195.9 MeV in excellent agreement with the observed 1197.4 MeV.

In the two baryons with the same quark composition, the difference in the masses between the two baryons is equal to the multiple of g*, and one baryon has morebond (with binding energy) than the other baryon, so a bond is added or subtracted in one of the two baryons. For example, the two baryons, Lambda (Λ^0) and Sigma (Σ^0), are uds. Lambda (Λ^0) has the mass of u + d + s – g* − E_{QQus1} + E_{QQus2} which is 1117.7 MeV in excellent agreement with the observed 1115.7 MeV. One bond is subtracted in Sigma (Σ^0) which has the mass of u + d + s which is 1196.1 MeV in excellent agreement with 1192.6 MeV.

The binding energies of dd, uu, du, uc, and ub are the same. The binding energies of ds, dc, and db are zero. For example, bottom Lambda (Λ_b^+) with udb has the mass of u + d + b − E_{QQub1} + E_{QQub2} which is 5608.7 MeV in excellent agreement with the observed 5619.4 MeV. Only one bond or less is allowed for the baryons with s, c, and b except in the two baryons with the same quark composition where one bond is added in one of the two baryons. For example, the two baryons, charmed Sigma (Σ_c^+) and charmed Lambda (Λ_c^+), are udc, Charmed Sigma (Σ_c^+) has the mass of u + d + c + 3g* − E_{QQuc1} + E_{QQuc2} which is 2449.4 MeV in excellent agreement with the observed 2452.9 MeV. One bond is added in charmed Lambda (Λ_c^+) which has the mass of u + d + c + g* − E_{QQuc1} + E_{QQuc2} − E_{QQud1} + E_{QQud2} which is 2286.3 MeV in excellent agreement with the observed 2286.5 MeV.

Without d/u, the baryons have no binding energy. For example, charmed Omega (Ω_c^0) with ssc has the mass of s + s + c which is 2683.4 MeV which is in excellent agreement with the observed 2695.2 MeV.

The calculated masses and the observed masses [10] of mesons are in **Table 5**. Since parallel spins have higher energy than antiparallel spins, vector mesons with parallel spins have higher masses than pseudoscalar mesons with antiparallel spins. For higher-mass vector mesons (parallel spins), vector t, b, c, and s are baryonic t, b, c, s, and vector d and u are baryonic d and u plus basic gluon (g*). For lower-mass pseudoscalar mesons (antiparallel spins), pseudoscalar t is a part of vector t, pseudoscalar b and c are vector quarks minus g*, and pseudoscalar d, u, and s are derived from g*.

The mass of $\pi^\pm$ is the mass of 2g* minus the mass of $e^\pm$ as proposed by Peter Cameron [17]. The calculated mass of $\pi^\pm$ is 139.5395 MeV which is in excellent agreement with the observed 139.5702 MeV. $\pi^\pm$ has much longer mean lifetime than other mesons to indicate that the composite of $\pi^\pm$ is not normal composite of u and d quarks. Another pseudoscalar meson with long mean lifetime is K^+ ($u\bar{s}$) which has the composition of 7g* + 7e with the calculated mass of 493.754 MeV in excellent agreement with the observed 493.677 MeV.

The mass of π^0 involves the composite of pseudoscalar u and pseudoscalar d quarks as $(u_p\bar{u}_p + d_p\bar{d}_p)/2$. The binding energy for pseudoscalar meson involves the auxiliary mass dimensional orbital at d = 7 similar to the binding energy in u and d quarks for baryons as Equation (16).The binding energy for pseudoscalar u and d does not involve 3 colors as in 3-color gluons, so similar to Equation (16), the primary binding energy for pseudoscalar u and d quarks at d = 7 with α_w as follows.

$$E_{Q1} = 3M_{g*}\alpha_w/2 = 2.911\text{ MeV} \tag{25}$$

The secondary binding energy is as follows.

$$E_{Q2} = 3E_{Q1}\alpha_w/2 = 0.121\text{ MeV} \tag{26}$$

The binding energy E_{QQ} for each dd, uu, and du bond is $2E_Q$. π^0 is $(u_p\bar{u}_p + d_p\bar{d}_p)/2$, so similar to Equation (20), the mass of π^0 is as follows.

$$M_{\pi^0} = Mu_p + Md_p - E_{QQ1} + E_{QQ2} = 134.982\text{ MeV} \tag{27}$$

which is in excellent agreement with the observed value 134.9766 MeV.

The binding energy for the ds bond and the us bond is three times of the d/u quark bond to form the composite boson with three flux quanta as follows.

$$E_{Q1} = 3\times 3M_{g*}\alpha_w/2 = 8.732\text{ MeV} \tag{28}$$

The secondary binding energy is as follows.

Table 5. The masses of mesons and the Higgs bosons.

Meson	Spin	Composition	Calculated mass without binding energy (MeV)	Calculated mass with binding energy (MeV)	Observed mass (MeV)	% difference
pion ($\pi^{\pm}$)	0	$2g^* - e$ as $u\bar{d}$	139.540		139.570	−0.02
pion (π^0)	0	$(u_p\bar{u}_p + d_p\bar{d}_p)/2$	140.562	134.982	134.977	0.004
charged rho meson (ρ^+)	1	$u_v\bar{d}_v$	797.11	774.07	775.11	−0.13
omegameson (ω)	1	$u_v\bar{d}_v$	797.11	785.59	782.65	0.32
eta meson (η)	0	$(u_p\bar{u}_p + d_p\bar{d}_p + s_p\bar{s}_p)/2$	563.949	548.663	547.862	0.15
eta prime meson (η')	0	$(u_p\bar{u}_p + d_p\bar{d}_p)/2 + s_p\bar{s}_p$	987.34	956.76	957.78	−0.11
kaon (K^+)	0	$7(g^* + e)$ as $u_p\bar{s}_p$	493.754		493.677	0.02
kaon (K^0)	0	$7(g^* + 2e)$ as $d_p\bar{s}_p$	497.331		497.614	−0.06
kaon (K^{*+})	1	$u_v\bar{s}_v$	937.7	891.60	891.66	−0.007
phi meson (ϕ)	1	$s_v\bar{s}_v$	1078.1	1018.9	1019.5	−0.06
D meson (D^{*0})	1	$c_v\bar{u}_v$	2004.0		2007.0	−0.15
strange D meson (D_s^+)	0 0	$e + 20(3g^*/2) - 2g^*$ $(c_p\bar{s}_p)$	1961.2 (1958.7)		1968.3	−0.36
strange D meson (D_s^{*+})	1 1	$e + 20(3g^*/2)$ $(c_v\bar{s}_v)$	2101.3 (2144.4)		2112.1	−0.52
charmed eta meson (η_c)	0 0	$2e + 30(3g^*/2) - 2g^*$ $(c_p\bar{c}_p)$	3012.1 (3070.6)		2983.6	0.95
J/Psi	1 1	$2e + 30\,(3g^*/2) - g^*$ $(c_v\bar{c}_v)$	3082.1 (3210.6)		3096.9	−0.48
D meson (D^0)	0	$c_p\bar{u}_v - g^*$	1863.9		1864.8	−0.05
D meson (D^{*0})	1	$c_v\bar{u}_v$	2003.8		2010.3	−0.32
B meson (B_d^0)	0	$d_v\bar{b}_p$	5303.1		5279.6	0.44
B meson (B_d^{*0})	1	$d_v\bar{b}_v$	5373.1		5325.2	0.89
B meson (B_c)	0 0	$e + 60(3g^*/2)$ $(c_p\bar{b}_p)$	6302.8 (6440.0)		6275.6	0.41
bottom eta meson (η_b)	0 0	$2e + 90(3g^*/2) - g^*$ $(b_p\bar{b}_p)$	9384.4 (9809.3)		9398.0	−0.14
upsilon meson (Υ)	1 1	$2e + 90(3g^*/2)$ $(b_v\bar{b}_v)$	9454.4 (9949.4)		9460.3	−0.06
top-bottom quark-antiquark composite	0	$b_p\bar{b}_p + (b_p\bar{b}_p + t_p\bar{t}_p)/2$	27.9 GeV		28 GeV	−0.3
pseudoscalartop quark-antiquark (absent)	0	$t_p\bar{t}_p$	26.4 GeV		not observed	
t quark	½	$t_7 + t_8$	175.4 GeV		172.4 GeV	1.71
perturbative Higgs boson (absent)	0	$W^+W^-Z^0$	252 GeV		not observed	
low Higgs boson	0	$W^+W^-Z^0/2$	126 GeV		125 GeV	0.79
high Higgs boson	0	$3W^+W^-Z^0$	756 GeV		750 GeV	0.8

$$E_{Q2} = 9E_{Q1}\alpha_w/2 = 1.089 \text{ MeV} \quad (29)$$

The mass of η as $(u_p\bar{u}_p + d_p\bar{d}_p + s_p\bar{s}_p)/2$ is as follows.

$$M_\eta = Mu_p + Md_p + Ms_p - E_{QQ1} + E_{QQ2} = 548.663 \text{ MeV} \quad (30)$$

which is in excellent agreement with the observed value 547.862 MeV.

The mass of η' as $(u_p\bar{u}_p + d_p\bar{d}_p)/2 + s_p\bar{s}_p$ is as follows.

$$M_{\eta'} = Mu_p + Md_p + 2Ms_p - 2E_{QQ1} + 2E_{QQ2} = 956.764 \text{ MeV} \quad (31)$$

which is in excellent agreement with the observed value 957.78 MeV.

The mesons with c, b, and t have no binding energy. For d_p and u_p in the pseudoscalar mesons with c and b, $d_p = d_b = d_v - g^*$, and $u_p = u_b = u_v - g^*$. For example, the mass of D meson (D^0) with $c_p\,\bar{u}_p$ is $c_p + u_p = c_p + u_v - g^*$ which is 1863.9 MeV in excellent agreement with the observed 1864.8 MeV.

The binding energy for vector dd, uu, and du bonds involves the same binding energy as baryonic d/u quark bond as Equations (16) and (17), so vector ρ^+ as $u_v\bar{d}_v$ with the binding energy derived from Equations (16) and (17) is as follows.

$$M_\rho = Mu_v + Md_v - E_{QQ1} + E_{QQ2} = 774.07 \text{ MeV} \quad (32)$$

which is in excellent agreement with the observed value 775.11 MeV. As in the baryons with the same quark composition, charged rho meson (ρ^+) and omega-meson (ω) have the same composition as $u_v\bar{d}_v$, so 1/2 bond is subtracted in omegameson (ω) which has the mass as follows.

$$M_\omega = Mu_v + Md_v - E_{Q1} + E_{Q2} = 785.59 \text{ MeV} \quad (33)$$

which is in excellent agreement with the observed value 782.65 MeV.

The binding energy for vector ds bond and us bond is twice of the binding energy for d/u quarks. The mass for kaon (K^{*+}) with $u_v\bar{s}_v$ is as follows.

$$\begin{aligned} M_{K^{*+}} &= Mu_v + Ms_v - 2E_{QQ1} + 2E_{QQ2} \\ &= Mu_v + Ms_v - 52.648 \text{ MeV} + 6.565 \text{ MeV} \\ &= 891.60 \text{ MeV} \end{aligned} \quad (34)$$

which is in excellent agreement with the observed value 891.66 MeV. The binding energy for vector ss bond has the opposite sign for E_{QQ2}, so phi meson (ϕ) as $s_v\bar{s}_v$ has the mass of $s_v + s_v$—52.648 MeV - 6.565 MeV which is 1018.9 MeV in excellent agreement with the observed 1019.5 MeV. The mesons with c, b, and t have no binding energy. For example, D meson (D^{*0}) with $c_v\bar{u}_v$ has the mass of $c_v + u_v$ which is 2004.0 MeV which is in excellent agreement with the observed 2007.0 MeV.

The masses of the mesons of c/b without d/u follow the meson mass formula by Malcolm H. MacGregor [18] to match the masses of mesons derived from the quark mass formula as Equation (15). The MacGregor's meson mass formula derived from the muon mass formula as Equation (4) is as follows.

$$M_{meson} = Me \text{ or } 2Me + 2n\left(3M_{g*}/2\right) \quad (35)$$

where one e is for charge meson and 2e for neutral meson, and n (integer) is determined by the masses of mesons calculated from the quark mass formula as

Equation (15). For example, the calculated mass of vector strange D meson (D_s^{*+}) as $c_v\bar{s}_v$ is c_v + s_v which is 2144.4 MeV. To match 2144.4 MeV, the MacGregor's meson mass formula generates e + 20(3g*/2) which is 2101.3 MeV in excellent agreement with the observed 2112.1 MeV. The mass different between pseudoscalar strange D meson (D_s^+) as $c_p\bar{s}_p$ and vector strange D meson (D_s^{*+}) as $c_v\bar{s}_v$ is 2g*. Strange D meson (D_s^+) has the mass of e + 20(3g*/2) − 2g* which is 1961.2 MeV in excellent agreement with the observed 1968.3 MeV.

The MacGregor's meson mass formula in Equation (35) for the mesons of c/b without d/u/s, n = the multiple of 3to simulate baryonic quark which uses 3μ as in Equation (9). For example, vector upsilon meson (γ) with $b_v\bar{b}_v$ has the mass of 2e + 90(3g*/2) which is equal to 9454.4 MeV in excellent agreement with the observed 9460.3 MeV. The mass difference between vector $b\bar{b}$ and pseudoscalar $b\bar{b}$ is the mass of g*. Pseudoscalar bottom eta meson (η_b) with $b_p\bar{b}_p$ has the mass of 2e + 90(3g*/2) − g* which is equal to 9384.4 MeV in excellent agreement with the observed 9398.0 MeV.

Pseudoscalar and partial t quark is t_7, while vector and full t quark is t_7 + t_8. Vector and full t quark with enormous mass is extremely short-lived, so top quark-antiquark does not have time before they decay to form hadrons, resulting in "bare" t quark and antiquark. The calculated mass of t is 175.4 GeV in good agreement with the observed 172.4 GeV.

The summary of binding energies in hadrons is in Table 6. The binding energies are derived from the auxiliary mass dimensional orbital at d = 7 as in Equations (16), (17), (18). (19), (22), (23), (25), (26), (28), (29), (32), and (34). In general, the relatively stable hadrons with d, u, and s quarks have binding energies, while relatively unstable hadrons with c, b, and t quarks and without u and d do not have binding energies. The baryons with the u and s/c/b bonds have binding energies, and the baryons with the d and s/c/b bonds do not have binding

Table 6. The binding energies in hadrons.

	Bond (QQ)	Primary (MeV)	Secondary (MeV)	Tertiary (MeV)	Equation
Baryon	dd, uu, du, uc, ub	26.324	3.282	0.409	16, 17, 18. 19
	us	8.775	0.365	0	22, 23
	ds, dc, db, baryons without d and u	0	0	0	
Pseudoscalar meson	dd, uu, du	5.822	0.242	0	25, 26
	ds, us	17.465	2.178	0	28, 29
	mesonswith c, b, and t	0	0	0	
Vector meson	dd, uu, du	26.324	3.282	0	32
	ds, us, ss	52.648	6.565	0	34
	mesons with c, b, and t	0	0	0	

energies. The mesons with c, b, and t quarks do not have binding energies. Pseudoscalar mesons have lower binding energies than baryons and vector mesons. In the two hadrons with the same quark composition, one hadron has more bond (with binding energy) than the other, so a bond is added or subtracted in one of the two hadrons.

4. The Top-Bottom Quark-Antiquark Composite

In the search for resonances produced in association with a b quark jet and a second jet, and decaying to a muon pair, the CMS Collaboration at the LHC recently reported an excess of events above the background near a dimuon mass of 28 GeV. The search is carried out in two categories from proton-proton collisions at center-of-mass energies of 8 and 13 TeV. The first category involves a b quark jet in the central region and at least one jet in the forward region, while the second category involves two jets in the central region, at least one of which is identified as a b quark jet, no jets in the forward region. At the 8 TeV collision, the first category has 4.2 standard deviation, while the second category has 2.9 standard deviations. At the 13 TeV collision, the first category has 2.0 standard deviations, while the second category results in a 1.4 standard deviation deficit.

As shown in Figure 1, Table 1, Table 3, and Table 5, pseudoscalar t quark is t_7 (13.2 GeV), while vector and full t quark (175.4 GeV) is $t_7 + t_8$. This paper posits that the resonance with 28 GeV observed recently at the LHC is the pseudoscalar top-bottom quark-antiquark composite which has the calculated mass of 27.9 GeV derived from the periodic table of elementary particles in good agreement with the observed 28 GeV as shown in Table 5. The calculated mass is the mass of three pseudoscalar b quarks and one pseudoscalar t quark which represent the composite of $b_p\bar{b}_p + (b_p\bar{b}_p + t_p\bar{t}_p)/2$. As described in the periodic table of elementary particles, pseudoscalar t quark is only a part of full t quark, so pseudoscalar $t_p\bar{t}_p$ (26.4 GeV) cannot exist independently, and can locate within a composite, such as the top-bottom quark-antiquark composite. As shown in the observation at the LHC, the resonance with 28 GeV weakens significantly at the higher energy collision (13 TeV), because at the higher collision energy, low-mass pseudoscalar $t\bar{t}$ in the composite likely becomes independent full high-mass vector $t\bar{t}$ moving out of the composite. The presence of the top-bottom quark-antiquark composite weakens, disappears, or gets inverted at 13 TeV as shown at the LHC. Normally, the presence of resonance gets stronger at the higher collision energy.

To account for the observed two jets, the composite has two jets consisting of a $b\bar{b}$ jet and a b + t jet for $(b_p\bar{b}_p + t_p\bar{t}_p)/2$, where $b\bar{b}$ jet is more stable than b + t jet which decays faster into the jet in the forward region to constitute the first category of the search by the CMS Collaboration at the LHC. Since $t_p\bar{t}_p$ is less stable than $b_p\bar{b}_p$, so the decay of the b + t jet is faster to allow the greater standard deviations for the first category than for the second category. The sum of the standard deviations from both categories is greater than 5.

5. The Higgs Boson Doublet

One important open theoretical issue about the Higgs boson is the triviality problem [19]. Within the perturbation theory, the Higgs boson mass squared is proportional to the self-coupling. However, the scalar self-coupling for the scalar Higgs boson leads to triviality or non-interaction which is inconsistent to the interactive Higgs boson. To deal with the triviality problem, Cea and Cosmai [20] [21] established the non-perturbation non-trivial rescaling of the Higgs condensate to avoid the vanishing self-coupling, resulting in the generation of the heavy Higgs boson with 754 GeV. According to Cea, the theoretical expectations of the predicted heavy Higgs boson (754 GeV) are in fairly good agreement with the observations at the LHC Run 2with an estimated statistical significance of more than five standard deviations [22].

This paper proposes that derived from the non-trivial rescaling of the Higgs condensate, the Higgs boson doublet consists of the high Higgs boson from the upward rescaling of the Higgs condensate and the low Higgs boson from the downward rescaling. The perturbative Higgs boson became the non-perturbative Higgs boson doublet irreversibly during the spontaneous symmetry breaking. The observed mass of the high Higgs boson is 750 GeV [22] [23] [24] [25], and the observed mass of the low Higgs boson is 125 GeV [26] [27].

This paper also proposes that the Higgs bosons are the intermediate vector boson composites whose condensate provides the masses directly to the intermediate vector bosons during the spontaneous symmetry breaking. The Higgs bosons consist of the perturbative Higgs boson ($W^+W^-Z^0$ = 252 GeV = M_{W+} + M_{W-} + M_{Z0}), the low Higgs boson ($W^+W^-Z^0/2$ = 126 GeV) from the downward rescaling, and the high Higgs boson ($3W^+W^-Z^0$ = 756 GeV) from the upward rescaling. The perturbative Higgs boson is absent, and there is no Higgs boson pair [28]. The low Higgs boson as $W^+W^-Z^0/2$ with respect to $W^+W^-Z^0$ is like one quark in a di-quark meson, while the high Higgs boson as $3W^+W^-Z^0$ with respect to $W^+W^-Z^0$ is like one baryon consisting of three quarks. In this way, the Higgs boson doublet from the rescaling provides the structures of the quark compositions for mesons and baryons which are not like leptons without composite structures. The calculated masses (126 GeV and 756 GeV) of the Higgs boson doublet are in excellent agreements with the observed masses (125 GeV and 750 GeV) [22]-[27]. For the periodic table of elementary particles, the Higgs mechanism assigns the mass of B_7 as the mass of Z^0. The mass of B_7 produces α_w which determines the masses of quarks as in the quark mass formula in Equation (15).

6. Summary

This paper posits that the observed resonance with 28 GeV at the LHC is the pseudoscalar top-bottom quark-antiquark composite which has the calculated mass of 27.9 GeV derived from the periodic table of elementary particles. The calculated mass is the mass of three pseudoscalar b quarks and one pseudoscalar t quark to represent the composite of $b_p\bar{b}_p$ + ($b_p\bar{b}_p$ + $t_p\bar{t}_p$)/2 where p = pseudoscalar. (The quark in pseudoscalar meson is denoted as "pseudoscalar quark", while the quark in vector mesons is denoted as "vector quark" which has higher mass than pseudoscalar quark.) In the periodic table of elementary particles, pseudoscalar t quark (13.2 GeV) is only a part of full t quark (175.4 GeV), so pseudoscalar $t_p\bar{t}_p$ (26.4 GeV) cannot exist independently, and can exist only in the top-bottom quark-antiquark composite. As shown in the observation at the LHC, the resonance with 28 GeV weakens significantly at the higher energy collision (13 TeV), because at the higher collision energy, low-mass pseudoscalar $t_p\bar{t}_p$ in the composite likely becomes independent full high-mass vector $t_v\bar{t}_v$ moving out of the composite. To account for the observed two jets, the composite has two jets consisting of a $b\bar{b}$ jet and a b + t jet, where $b\bar{b}$ jet for ($b_p\bar{b}_p$ + $t_p\bar{t}_p$)/2 is more stable than b + t jet which decays faster into the jet in the forward region to constitute the first category of the search by the CMS Collaboration at the LHC.

The periodic table of elementary particles is based on the seven mass dimensional orbitals derived from the seven extra dimensions of 11 spacetime dimensional membrane particles. The seven mass dimensional orbitals include the seven principal mass dimensional orbitals for stable baryonic matter leptons (electron and neutrinos), gauge bosons, gravity, and dark matter and the seven auxiliary mass dimensional orbitals for unstable leptons (muon and tau) and quarks, and calculate accurately the masses of all elementary particles and the cosmic rays by using only five known constants. For baryons, the quarks in the periodic table of elementary particles are baryonic quarks. For high-mass vector mesons (parallel spins), vector t, b, c, and s are baryonic t, b, c, s, and vector d and u are baryonic d and u plus basic gluon (g^* = 70 MeV) which has the mass of electron/α where α is the fine structure constant of electromagnetism. For low-mass pseudoscalar mesons (antiparallel spins), pseudoscalar t is a part of vector t, pseudoscalar b and c are vector quarks minus g^*, and pseudoscalar d, u, and s are derived from g^*. The binding energies among quarks are derived from the auxiliary mass dimensional orbital. With these masses and binding energies of quarks, the masses of hadrons can be calculated in excellent agreement with the observed masses of hadrons by using only five known constants in the periodic table of elementary particles. For examples, the calculated masses of proton, neutron, pion ($\pi^\pm$), and pion (π^0) are 938.261, 939.425, 139.540, and 134.982 MeV in excellent agreement with the observed 938.272, 939.565, 139.570, and 134.977 MeV, respectively with 0.0006%, 0.01%, 0.02%, and 0.004%, respectively for the difference between the calculated and observed mass. The calculated masses of the Higgs bosons as the intermediate vector boson composites are in excellent agreements with the observed masses. In conclusion, the calculated masses of the top-bottom quark-antiquark composite (27.9 GeV), hadrons, and the Higgs bosons by the periodic table of elementary particles are in excellent agreement with the observed masses of resonance with 28 GeV at the LHC, hadrons, and the Higgs bosons, respectively.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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