Dynamical Pattern of Elementary Particles

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Abstract

This purpose of this present paper is to present the simple idea to introduce a mathematical model to predict some possible particles (and may be its systems) that might exist beyond standard model of particle physics. The idea that is discussed in this present note must somehow* be the particle does not belong to fermions or bosons but more exotic. This paper is purely theoretical which gives hypothetical flavor of particles that possibly claims to exist in nature, based on the weird but interesting mathematical sketch. This note has been done by keeping one sentences in mind that the existing particles can reveal the zoo of other unknown particles.

Keywords: Particle Matrices, quarks, component.

All the known (or may be some unknown particles) are originated from big bang so there must be a common factor to define its behavior and its birth via gigantic transformation** and in fact these known particles can reveal other of their friends***. In particle physics standard model plays a key role in explaining the obvious behavior of fundamental particles and interactions. The predictions from standard model are all confirmed including the quantum excitation of Higgs field (that generates mass due to electroweak gauge symmetry breaking). No more words let us move towards mathematical argument to form the fundamental basis of the present paper.

The mathematical requirement requires the introduction of mathematical idea here considered. The key idea is to define the mathematical setup notation as ψ_n which we would like to call as "Particle Matrices" it can be defined as proposed with four individual components.

$$\psi_n = \begin{pmatrix} \varphi_1 & \varphi_2 \\ \varphi_4 & \varphi_3 \end{pmatrix}$$

If $\varphi_1\varphi_2\varphi_3\varphi_4$ are the four components of the particle matrices and φ_4 is the predicting component in the matrices, the necessary mathematical formulation can be defined as follows

$$\psi_n = \begin{pmatrix} \varphi_1 & \varphi_2 \\ \varphi_4 & \varphi_3 \end{pmatrix} = 0$$

Our massive limitation is the choice of four components to predict a particle in terms of weird but interesting mathematical model.

If we want to obtain the other particles from elementary fermions one must define such rules mentioned below by incorporating the fourth component φ_4

$$\psi_n = \begin{pmatrix} \varphi_1 & \varphi_2 \\ \varphi_4 & \varphi_3 \end{pmatrix} = 0$$

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The basic equation of the components (the pattern) can be given as

$$\varphi_1\varphi_3 + (\varphi_2 - \varphi_4) = 0$$

Consequently it follows

$$\varphi_1\varphi_3 = -(\varphi_2 - \varphi_4)$$

Such that it is mentioned earlier that

$$\psi_n = 0$$

Or the mathematical mechanism simply follows

$$\psi_n = \begin{pmatrix} \varphi_1 & \varphi_2 \\ \varphi_4 & \varphi_3 \end{pmatrix} = \varphi_1\varphi_3 + (\varphi_2 - \varphi_4) = 0$$

However there are several important rules which must be expressed.

Note:

1. No same particle's spin or charge cannot be repeated in choosing the components.

2. The above defined four parameters now will be charge and spin components of particles.

3. The charge and spin are taken here, of only particles that are discovered in nature.

4. The choice of spin and charge must be separate.

5. The particles can be described only by charge or only by spin based on independent choice. The resultant particle's charge and spin (if calculated) in this mathematical approach are taken as separate.

We will use fermions (only quarks) to predict the particles which may possibly exist in nature

For instance let us use boson

First consider the three components be the spin of bosons such that keeping the rules in mind first choice will therefore form

$$\varphi_1 = spin\ of\ first\ gauge\ boson\ (photon)$$

$$\varphi_2 = spin\ of\ second\ gauge\ boson\ (gluon)$$

$$\varphi_3 = spin\ of\ third\ gauge\ boson\ (assuming\ only\ w\ boson\ for\ weak\ interaction)$$

$$\psi_n = \begin{pmatrix} 1 & 1 \\ \varphi_4 & 1 \end{pmatrix}$$

From fundamental equation mentioned above we can predict the fourth component

$$\varphi_1\varphi_3 + (\varphi_2 - \varphi_4) = 0$$

Such that the component φ_4 must have a spin 2 and needs to be elementary (as we include vector bosons), which indeed preliminary a spin 2 boson which is not yet observed but many theories predict that graviton which is also a gauge boson of have spin 2. Simply means that our spin 2 boson must or must not be a graviton but indeed it's a spin 2 boson, if observed then our formulation of particle matrices is indeed correct. Spin 2 boson is beyond standard model of particle physics.

Taking charge of discovered baryons

$$\varphi_1 = charge\ of\ a\ Delta ++\ (+2)$$

$$\varphi_2 = charge\ of\ a\ proton\ (+1)$$

$$\varphi_3 = charge\ of\ a\ positive\ sigma\ (+1)$$

$$\psi_n = \begin{pmatrix} +2 & +1 \\ \varphi_4 & +1 \end{pmatrix}$$

Component 4 thus becomes a particle of charge +3 or any particle of charge (+++) integer. This simply means a particle of integer charge +3 may exist beyond the standard model of particle physics. Clearly it shows that baryons, mesons and tetraquarks (predicted below) must not posses charge +3 if and only if these particles are made with standard model six types of quarks. Any new type of particle might posses charge +3

However this particle may be composite or elementary. If composite then, we are not truly sure about its constitution.

Now for instance let us simply use the notation that meson which is a composite boson contains two quarks say N=2. Now simply use rule as follows

$$\varphi_1 = meson\ 1$$

$$\varphi_2 = meson\ 2$$

$$\varphi_3 = meson\ 3$$

Or setting

$$\psi_n = \begin{pmatrix} m_1 & m_2 \\ \varphi_4 & m_3 \end{pmatrix} = \begin{pmatrix} N_1 & N_2 \\ \varphi_4 & N_3 \end{pmatrix}$$

Where N_1 is the number of quark and m_1 is the first meson contains in meson which is 2, so simply $N_1 = N_2 = N_3$

Using equation

$$\varphi_1\varphi_3 + (\varphi_2 - \varphi_4) = 0$$

We thus arrive that $\varphi_4 = 6$ which therefore must be a particle composed of six quarks simply hexaquark.

Using simple expressions one can deduce that if baryon (contains three quarks)B and meson (contains two quark) then

$$B + m = h$$

Where h is pentaquark. Here B and m are denoted by their number of quarks N

Simply if T is the tetraquark (contains 4 quarks)

$$T + m = H$$

Where H is the hexaquark.

Therefore from our simple mathematical patterns we predict that tetraquark and hexaquark particle should and must exist.

For quarks charge

Choice 1

$$\varphi_1 = charge\ of\ a\ up\ quark\ (+2/3)$$

$$\varphi_2 = charge\ of\ a\ down\ quark\ (-1/3)$$

$$\varphi_3 = charge\ of\ a\ charm\ quark\ (+2/3)$$

$$\psi_n = \begin{pmatrix} +2/3 & -1/3 \\ \varphi_4 & +2/3 \end{pmatrix}$$

Component 4 thus becomes a particle of charge of +1/9

Choice 2 for charge

$$\varphi_1 = charge\ of\ a\ down\ quark\ (-1/3)$$
$$\varphi_2 = charge\ of\ a\ up\ quark\ (+2/3)$$

$$\varphi_3 = charge\ of\ a\ charm\ quark\ (+2/3)$$

$$\psi_n = \begin{pmatrix} -1/3 & +2/3 \\ \varphi_4 & +2/3 \end{pmatrix}$$

Component 4 thus becomes a particle of charge of +4/9

Choice 3

$$\varphi_1 = charge\ of\ a\ up\ quark\ (+2/3)$$
$$\varphi_2 = charge\ of\ a\ down\ quark\ (-1/3)$$

$$\varphi_3 = charge\ of\ a\ bottom\ quark\ (-1/3)$$

$$\psi_n = \begin{pmatrix} +2/3 & -1/3 \\ \varphi_4 & -1/3 \end{pmatrix}$$

Computing we get the component φ_4 is of charge -5/9, say $\theta = -\frac{5}{9}$

Choice 4

$$\varphi_1 = charge\ of\ a\ strange\ quark\ (-1/3)$$

$$\varphi_2 = charge\ of\ a\ down\ quark\ (-1/3)$$

$$\varphi_3 = charge\ of\ a\ bottom\ quark\ (-1/3)$$

$$\psi_n = \begin{pmatrix} -1/3 & -1/3 \\ \varphi_4 & -1/3 \end{pmatrix}$$

We get the component φ_4 is of charge -2/9, say $\emptyset = -\frac{2}{9}$

Choice 5

$$\varphi_1 = charge\ of\ a\ top\ quark\ (+2/3)$$
$$\varphi_2 = charge\ of\ a\ up\ quark\ (+2/3)$$

$$\varphi_3 = charge\ of\ a\ charm\ quark\ (+2/3)$$

$$\psi_n = \begin{pmatrix} +2/3 & +2/3 \\ \varphi_4 & +2/3 \end{pmatrix}$$

We get the component φ_4 is of charge +10/9, say $\emptyset_p = +\frac{10}{9}$

Choice 6

$$\varphi_1 = charge\ of\ a\ down\ quark\ (-1/3)$$

$$\varphi_2 = charge\ of\ a\ top\ quark\ (+2/3)$$

$$\varphi_3 = charge\ of\ a\ strange\ quark\ (-1/3)$$

$$\psi_n = \begin{pmatrix} -1/3 & +2/3 \\ \varphi_4 & -1/3 \end{pmatrix}$$

We get the component φ_4 is of charge +7/9, say $\emptyset_q = +\frac{7}{9}$

Charges of newly predicted particles must be

$A = +1/9, B\ =\ +4/9, \theta = -\frac{5}{9}, \emptyset = -\frac{2}{9}, \emptyset_q = +\frac{7}{9}, \emptyset_p = +\frac{10}{9}$

All others detailed analysis must be experimental.

These particles must have their own antiparticle given by equation based on charge choices

$$\varphi_1\varphi_3 + (\varphi_2 + \varphi_4) = 0$$

Simply

$$\psi_n = \begin{pmatrix} \varphi_1 & \varphi_2 \\ \varphi_4 & \varphi_3 \end{pmatrix} = \varphi_1\varphi_3 + (\varphi_2 + \varphi_4) = 0$$

Formula for calculating the charge of quarks

According to Mr. Murray Gell-Mann three flavors of quark exists (discovered six) up, down and strange for which the charge must be given by Gell-Mann Nishijima formula

Form 1 Gell-Mann Nishijima formula

$$Q = e\left[I_3 + \frac{1}{2}(B + S)\right]$$

However the above formula does not sufficiently satisfy other three quarks, therefore independently

We derived empirical relations for the charge of other three quarks charm, top and bottom

Form 2 our equations

$$Q = e[I_3 - 2(S - B)]$$

Form 2 is true for charm quark and top quark

Form 3

$$Q = e(I_3 + S - B)$$

Form 3 is true for bottom quark

Where I_3 is the isospin spin of quark, S is the strangeness, e=+1 and B is the baryon number.

Many serious speculative theories predict many new fundamental and composite particles, however these serious theories are yet not proved. Our effort in this context is to show that fermions (baryons) of total angular momentum $\pm\frac{3}{2}$ exist and few have been discovered and its total angular momentum is determined mathematically means theoretically using quarks relation. The equation is as proposed

$$J' = \left[I_3 + \frac{q^+}{e} + \frac{J}{B} + \frac{2q^-}{e}\right]$$

$J' =$ Total singular momentum of a fermions, B = baryon number of quarks, q^+ = positive charged quark = $+\frac{2}{3}e$, q^- = negative charged quark = $-\frac{1}{3}e$ and J = spin of usual fermions i.e. ½$\hbar$.

Our aim here is to show that baryon of spin 3/2 exists which bears quarks of both charges (2/3 and -1/3) like the baryon of usual spin ½ which contains quarks of both charges.

This equation is the mathematical pattern that relates the baryon number of quarks, charge of quarks (both charges) and total angular momentum of usual baryon of magnitude ½ to the angular momentum of baryons of magnitude 3/2. Considering the proton from our baryon chart which is the first ever baryon of spin 1/2, in our formula quarks is the only key and suitable particle here taken to unlock the other baryon of different spin (3/2).

Note: the baryon of spin 3/2 must contain quarks of both charges as because our formula has charges parameters, the formula or the pattern from which the spin 3/2 is theoretically obtained by the choice of usual spin ½ baryons whose quark contains both charges (eg the proton, neutron)

At $I_3 = 0\ spin\ is\ \frac{3}{2}, I_3 = \frac{1}{2} spin\ is\ 2\ and\ I_3 = -\frac{1}{2}\ spin\ is\ 1$

Clearly spin 1 and 2 is boson and spin 2 is not discovered hence predicted.

Exception from this pattern: the spin 3/2 baryon consists of one kind of charged quark (either 2/3 or -1/3) may exist.

The best experimental vindication of our claim is the particle whose quark combination is same as proton but bears a spin 3/2. Our mathematical pattern states a particle must contain both charges quark and bears a spin 3/2 which indeed is proved.

However we have predicted the charge of other new particles above which we strongly believe to exist in nature.

Consequently for spin choice, since fermions have spin ½ therefore

Setting spin choices we get

Since all quarks (fermions) of spin half therefore

$$\varphi_1 = 1/2$$

$$\varphi_2 = 1/2$$

$$\varphi_3 = 1/2$$

$$\psi_n = \begin{pmatrix} 1/2 & 1/2 \\ \varphi_4 & 1/2 \end{pmatrix}$$

We obtain φ_4 of spin ¾ , therefore the new particle of spin ¾

Other choice (since spin of quarks can be $\pm\frac{1}{2}$)

$$\varphi_1 = 1/2$$

$$\varphi_2 = -1/2$$

$$\varphi_3 = 1/2$$

$$\psi_n = \begin{pmatrix} 1/2 & -1/2 \\ \varphi_4 & 1/2 \end{pmatrix}$$

We obtain φ_4 of spin ¼, therefore the new particle of spin ¼

So all possible spin choice will give spin $\pm\frac{1}{4}\ and\ \pm\frac{3}{4}$

Other prediction: spin of all six new particles may be somehow based on the figures ¾,-3/4, ¼, -1/4 or any other particle may exist of above predicted spins. Therefore these particles must not be fermions or bosons but something super exotic and highly exciting.

This particle matrices works with bosons, leptons and hadrons (mesons and baryons)

However these particles above mentioned must needs to be experimentally confirmed in super high energy accelerators, these particles must decay in a very tiny fraction of a fraction of a second because it is very unstable and produce in extreme high energy collisions. All others properties must be determined experimentally. If any other theoretical explanations it will be present elsewhere.

The search for these particles through experiments at super high energies is highly suggested.

* The agreement will complete when we will observe these particles.

** The known particles are formed due to something unknown transformed during big bang.

*** The garden of other unknown particles.