Hexark and Preon Model #8 and the unification of forces

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Abstract

Model#7 extended the previous model by including spin 2 gravitons which are now withdrawn in model#8 and replaced by spin 1 gravitons. The reason for the change to spin 1 gravitons was the realisation that spin 1 gravitons together with a unified use of colour charge can unite the forces of QCD, QED, Weak and gravitation in a way that shows the commonality of all charges (Figure A). This commonality is outside the range of the Standard Model as there is a symmetry at the level of preons which is broken by aggregation of preons into elementary particles. At the preon level, the QED charge on preons derives exactly from the QCD charge. Because of aggregation of preons into quarks, that symmetry is broken at the level of quarks. A red quark can be either positive or negatively charged which hides the symmetry present at the level of preons.

Unification of charges

In model#8 there are three colour sources of charge. These charges give rise to all charges including those in Quantum Chromodynamics (QCD), Quantum Electrodynamics (QED), Weak force and gravity. This model gives an insight into what these charges are. The universe has a time direction with an arrow of time. Particles can be matter or antimatter where antimatter, on Feynman diagrams, travel in the reverse direction to time's arrow. In some sense, the matter in the universe is travelling at speed c through some unknown dimension orthogonal to its three spatial dimensions. There is some form of kinetic energy, orthogonal to the three spatial dimensions, associated with this motion. This kind of kinetic energy associated with the colour charges/dimensions is what drives the charges in particle physics.

The red charge requires a universe like our own, but one which is compactified, from our point of view, compared to our space. Redness implies travelling in that compactified universe in a direction conforming to its own red arrow of time. Antired implies travelling in the reverse direction to its arrow of time. The green charge requires a similar, but different, universe to the 'red' universe; and similarly the blue charge requires its own 'blue' compactified universe. Redness at this point is merely a label but it is important that the three compactified 'colour' universes are different so three names are needed. At this stage in the explanation, there are four universes: our own, plus three coloured compactified universes, having sixteen dimensions in total. Our 4D space and time is represented merely by chiral spin which can be left-handed or right-handed. Handedness of spin also brings with it the need for a time's arrow so that a LH spin for a matter particle is equivalent to a RH spin for an antimatter particle. Building red, green, blue and spin into hexarks and preons links the properties of the universe's dimensions directly to fundamental properties of particles.

Using a strand of fibre optics as an analogy to a colour dimension, every charge is built up from a 4D strand {which occupies the seventh layer of particle in this model: septarks}. A fibre optic strand has 4D of space and time, but also has a direction of travel for the light shining along it. That direction of travel along the fibre will be analogous to the direction of travel in the coloured universe; red in the direction of the red time's arrow and antired in the other direction.

Next we need to provide the three colour charges with a group structure, which is achieved through braiding. Coloured light has long been used to illustrate the group relationship between QCD quarks and gluons. In particular, red light holds in it some element of blue and green. Ditto for the other two colours in turn. Further, red, green and blue light have opposites or anticolours as cyan, magenta and yellow, respectively. Adding colour to anticolour light makes grey or zero colour, so red + antired = red + cyan = zero or grey and moreover cyan = green + blue. All these light relationships apply in some way to QCD colours and are an essential part of QCD's group relationships. To establish a relationship, start with some strands of pure red, green and blue colour and their pure anticolours. These pure strands are completely independent and have no useful group structure. Then braid pure strands three at a time so that you have a red + antigreen + antiblue braid, and ditto for a green + antiblue + antired braid and thirdly, a blue + antired + antigreen braid. These three unpure braids are RED, GREEN and BLUE such that adding the RED and GREEN braids gives net antiblue while adding RED + GREEN + BLUE braids gives colour neutrality, just as in adding QCD colours. Colour neutrality does not imply complete zero as RED + GREEN + BLUE makes WHITE which has negative electric charge at this level of sub-elementary particle. Note that ANTIRED + ANTIGREEN + ANTIBLUE aggregates to BLACK which is positively charged.

For forces to be capable of unification, the colours above must be an essential part of every kind of charge. That is, all forces must depend on the braided charges RED, GREEN, BLUE, ANTIRED, ANTIGREEN, ANTIBLUE, WHITE and BLACK. BLACK plus WHITE is completely NEUTRAL, and GREY, or zero, describes this kind of complete neutrality which also plays a role in particle construction. The colour charges can be assumed to play a direct role in QCD in quarks and gluons. It needs to be shown that WHITE is equivalent to negative electric charge and that each of RED, GREEN and BLUE carries net negative electric charge at the sub-elementary particle level, that is at the level of colour braids. It will be assumed that this relationship holds for colour braids and then it will be shown how to combine these braids so that the relationship is hidden for elementary particles. This relationship is analogous to a hidden symmetry which is broken when aggregating across braids, that is, the symmetry is present for preons but is broken for quarks. The full details of how this occurs for QCD is previously given by Fearnley (November 2015, Table 6) but a brief explanation follows. Braids have a direct relationship between colour and electric charge: RED (-1/6), GREEN (-1/6), BLUE (-1/6), ANTIRED (+1/6) ANTIGREEN (+1/6), ANTIBLUE (+1/6) while WHITE (= RED + GREEN + BLUE = -1/2) and BLACK (= ANTIRED + ANTIGREEN + ANTIBLUE = +1/2). In any quark, redness would be derived from preon colours RED (-1/6) + ANTIGREEN (+1/6) + ANTIBLUE (+1/6) which has a net electric charge of +1/6. In the down quark, a WHITE aggregate is added to the red to make [by analogy with painting, a pastel pink with] a net charge of -1/3 (= +1/6 - 1/2). For an up quark a BLACK aggregate is added to the red to make (a dark red with) a net electric charge of +2/3 (= +1/6 + 1/2). This establishes that a direct link exists between QCD colour and QED electric charge for preons that leads to the known electric charges for quarks and enables a unification of the source of QCD and QED through colour braiding at preon and sub-preon level.

How does the weak force fit into this system? Weak isospin contributes to electric charge but can be nullified by weak hypercharge in a dynamic fluctuation involving a higgs field happening at field level rather than by particle interaction. The elementary particles which have weak isospin as eigenstates are left handed (that is with negative spin). The higgs field has either positive or negative weak isospin eigenstates. Without delving far (see Fearnley {November 2015} and Fearnley {May 2015}) into the intricacies of weak isospin, it is enough for this paper to note that weak isospin is directly equivalent to electric charge by the formula:

Electric charge = weak isospin + 0.5 * weak hypercharge .

This makes the weak force fundamentally equivalent in its source to electric charge. The complication is that electric charge in the form of weak isospin is distributed around space, in the vacuum in a higgs field, rather than bound in a particle. Sometimes, of course, a higgs field is bound into a single particle when a higgs boson is formed in a high energy interaction. So the difference between a higgs field and a higgs boson is simply a difference in state of the higgs. In any case, the weak charge can be accounted for by BLACK and WHITE 'Weak' braids carrying negative and positive electric charge which disperses into the higgs fields.

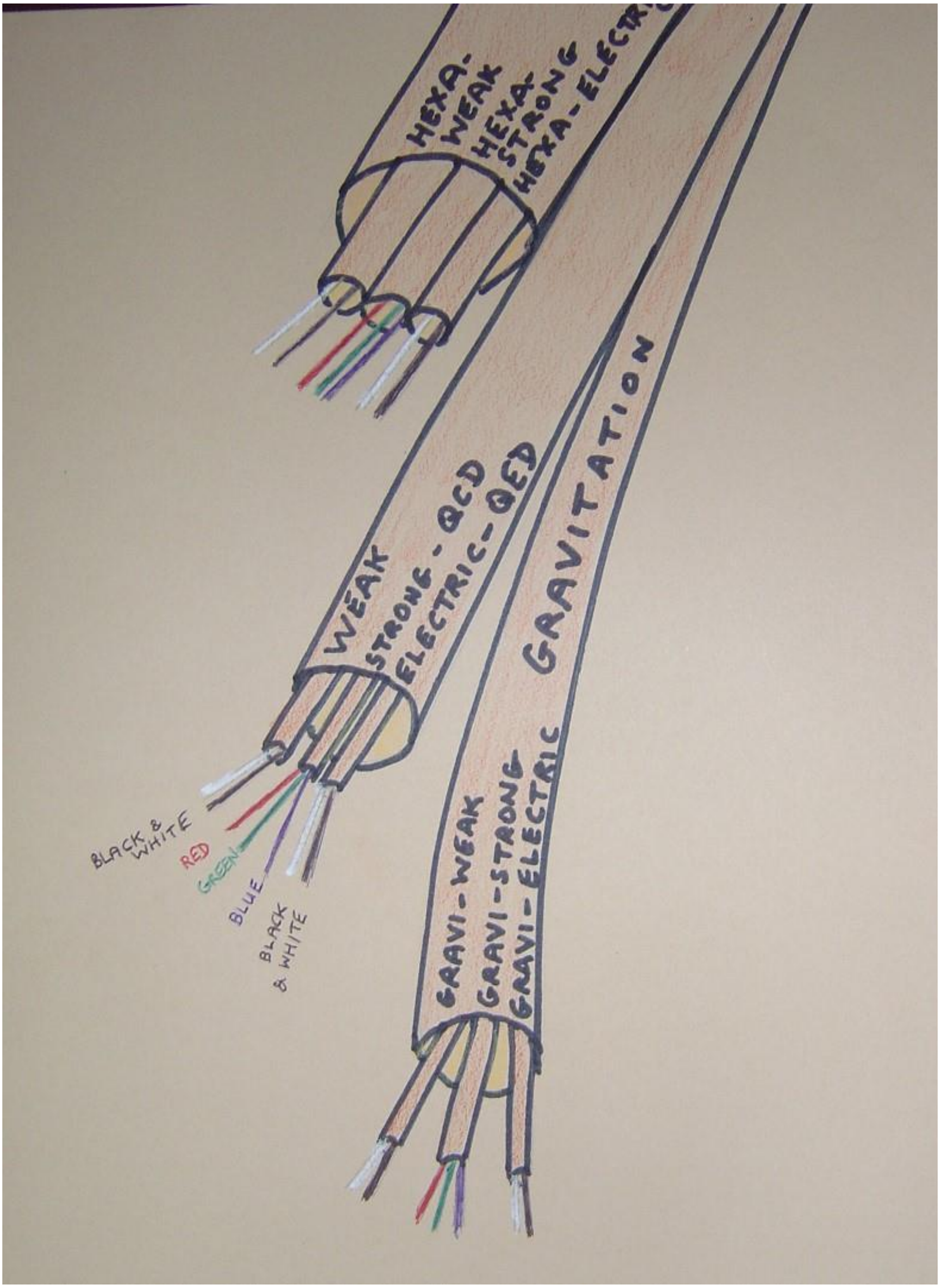
The three forces of strong, weak and electric are now seen to have a common origin in red, green and blue colour braids at sub-elementary particle level. It is useful to see these three forces as forming a single generational unit. In model#8, there are three such generations at play. The middle generation accounts for QCD, QED and Weak forces. A higher generation of hexa-QCD, hexa-QED and possibly hexa-weak accounts for hexacharge forces keeping the colour braids attracted and repelled as appropriate within the preons. A lower generation of gravi-QCD, gravi-QED and gravi-weak accounts for gravitational forces. The label 'colour' merely identifies which one of the set of three 4Ds is being used and therefore the same set of three 4D dimensions must be being used in all the forces. That is, the same 'colours' must apply across all forces. As the four forces vary in strength the quantity of colour must vary according to the force strength. Returning to the analogy of strands of fibre optics, the number of strands involved must be smallest for gravitation and largest for the new hexacharge, with QCD in between. All the forces must be caused by varying numbers and combinations of colour strands (or septarks) and this allows a unification of all the forces (as one traces their separations back in time to the Big Bang).

Next, how do the varying strengths of forces arise? Suppose our full-sized 3D space be represented by a 2D plane. Let a 4D red strand move at random into, and out of this 2D sheet in an immensely long random walk so that the 2D plane is touched or crossed by the strand a staggeringly large number of times. As the red 4D's time direction is unrelated to our time direction, in the 2D plane, the red strand can travel from point A on the 2D plane and reappear at point B in the 2D plane in our past. As the red strand is not limited in its travel by our time dimension, it can criss-cross at point A as often as it likes. The 4D red strand can fill and overlay the 2D plane multiple times and in any time order. But how many (septark) strands are needed to comprise the QCD-red colour in a hexark? As QCD-red and gravi-red are made of the same red strands there could be about 10^39 times more strands in QCD than for gravitation as that is the factor by which QCD force is greater than gravitational force.

Assuming that we can now envisage a system of cables of braids representing the forces, QCD is represented by cables containing a (vast array) of individually accessible colour strands which have an overall net zero (or GREY) aggregate colour. QED is represented by a similar-sized cable which has two parts: one part is a net white (negative electrical charge) and the other part is a net black (positive electrical charge, or 'hypertone'). QED gets its whiteness/blackness from a tailor-made white or black cable and the weak force has its source in the same BLACK and WHITE origins arising from a combination of colours in, say, the QCD cable. Call this, for simplicity, a third cable labelled the 'weak isospin' cable strapped to the main QCD cable.

The completely unified force dimensions are represented by a single, huge and homogeneous original [net GREY] cable of (unpure and hence with a group structure) coloured and anticoloured braids of pure colour strands. This cable forks into two unequal pieces, a massive cable for the hypothesised very strong hexacharge and a smaller cable for the remainder. The remainder fork splits into a very small gravitation cable and another remainder cable. This remainder cable splits into the QCD charge cable and the QED cable. Each cable is comprised of the same type of assembly of colour strands but the QED cable is net white or net black while the QCD cable has accessible imbalances of colours, although being net GREY. A further (weak isospin) cable splits off from, say, the QCD cable and contains white and black electrically charges assemblages of strands obtained direct from the QCD colours. The three generations are illustrated in Figure A and the application of the three colour braids to gravitation will be discussed in the next sections.

Figure A: Three generations of forces: 1. Hexacharge, 2. QCD/QED/Weak, 3. Gravitation



The hexarks for QCD, QED and Weak

The arrangement of hexarks into preons and sub-preons is shown in Appendix I. The structure of a hexark is simpler in Model#8 than in previous models. A hexark, for the purposes of QED, QCD and Weak, is composed of three components: spin (+ or -), weak isospin (+ or -) and colour (r, g, b, r', g' or b'); where r' is antired. The qualities left- or right-handedness (in space) and matter or antimatter (in space) have been omitted as although they have long been used in earlier versions of this model they no longer serve a current function for preons, only a redundant use in previous descriptions of the hexark structure.

A hexark can have one of the following 24 forms:

- - r	- - g	- - b
- + r	- + g	- + b
+ - r	+ - g	+ - b
+ + r	+ + g	+ + b
- - r'	- - g'	- - b'
- + r'	- + g'	- + b'
+ - r'	+ - g'	+ - b'
+ + r'	+ + g'	+ + b'

(Spin, weak isospin and colour properties; and r' denotes antired.)

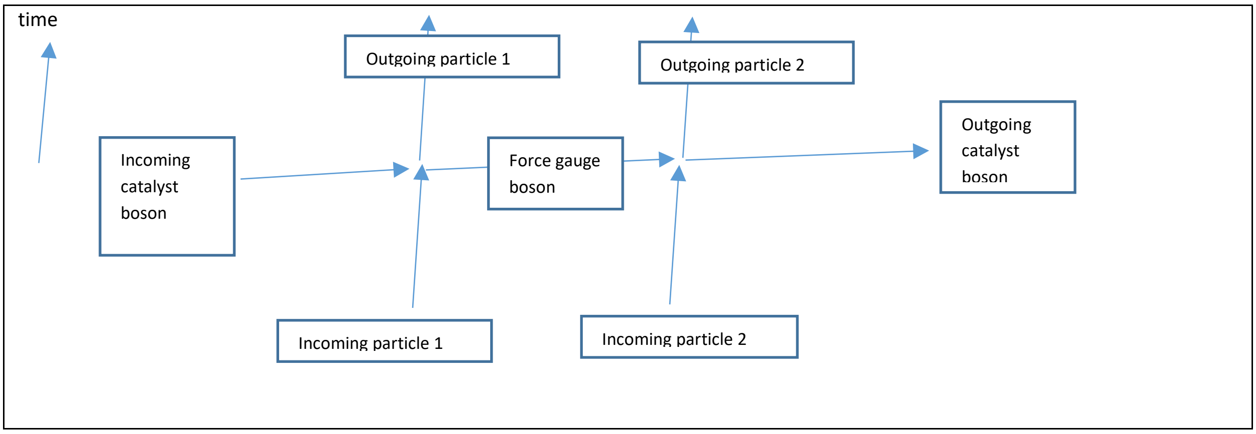
An individual hexark's electric charge is + or - 1/24; a hexark's spin is + or - 1/24; a hexark's weak isospin is + or - 1/24. A hexark's hexatone is also + or - 1/24 derived from its colour/anticolour: r, g and b each have hexatone = -1/24 and r', g' and b' each have hexatone = +1/24. Electric charge for the preons is determined exactly by colour (negative electric charge) and anticolour (positive electric charge) so that electric charge is not a separate fundamental quality.

Weak isospin is derived from electric charge in the higgs field and so depends on white or black aggregates of colour or anticolour charges, respectively.

QCD, QED and Weak interactions

The QCD, QED and Weak interactions are covered, without alteration required, in the report on Preon Model#7 (Fearnley, November 2015). The report on Model#7 shows particle interactions as being like chemical interactions of molecules, but whereas chemical interactions have molecules exchanging elements, particle interactions have elementary particles exchanging preons. The idea is used of balancing the numbers of preons contained on each side of a particle interaction. This idea also eschews the idea of elementary particles being equivalent to 'pure' energy. Preons can be termed 'matter' or 'antimatter', and elementary particles are made not of pure energy but of preons which in turn are made of hexarks which in turn derive their driving force from their colour or anticolour charges. Energy is certainly needed to allow a particle interaction, but the vacuum is full of who-knows-what and certainly full of higgs fields which often appear as catalysts in particle interactions in Models#7 and #8 (see Figure B), and the higgs plays a big role in model#8 in all of QED, Weak and QCD interactions.

Figure B Generalised diagram for the exchange of a force gauge boson between two particles, involving two interactions

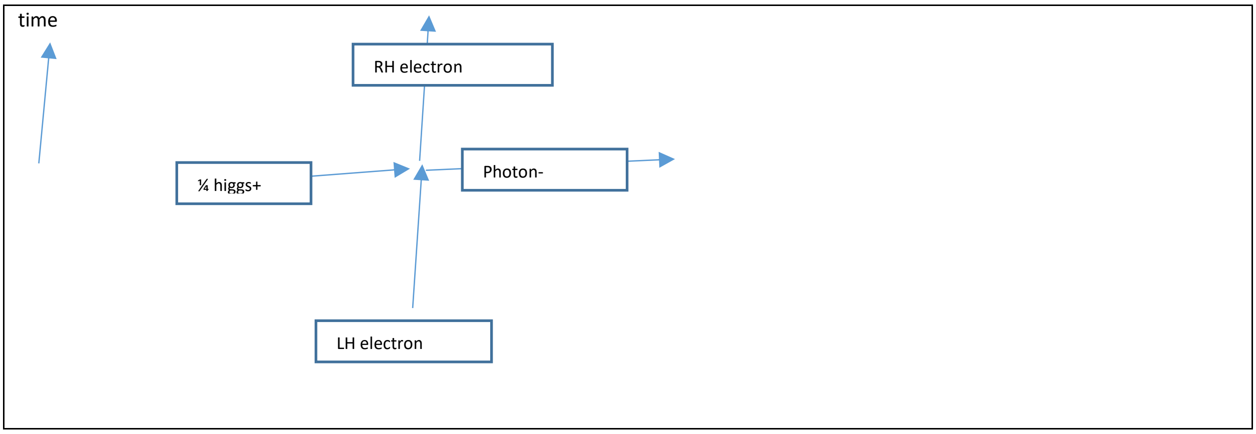


In QED, consider an electron emitting a photon. In preon models#7 and #8, this can be accomplished by a hidden ¼ higgs interaction with a LH electron to produce a RH electron plus a photon with spin -1. So, rather than an electron somehow gaining enough energy to emit a photon, the electron instead has enough energy to interact with a ¼ higgs field or particle hidden in the vacuum and uses the preons in the incoming higgs to provide the matter which is inside the outgoing particles (see Figure C).

LH electron + ¼ higgs+ -> RH electron + photon-
(-1, -0.5, -0.5) + (0, 0, 0.5) -> (-1, 0.5, 0) + (0, -1, 0)
Where parentheses are (electric charge, spin, weak isospin).
The interaction expressed in terms of preon exchange is:
ACx^1 + A'B'CC → BCx^1 + CCB'B'.
Where x^1 can be AA' or BB' or CC' or EE'.

Whether the ¼ higgs acts as a particle or a field, in this interaction the higgs property of -0.5 weak isospin was originally in the vacuum but disappeared from the vacuum after the interaction.

Figure C The conversion of a LH electron to a RH electron plus photon



The conversion of a LH red up quark to a RH red down quark can be shown as:

LH red up + RH W- -> RH red down + ½ higgs+

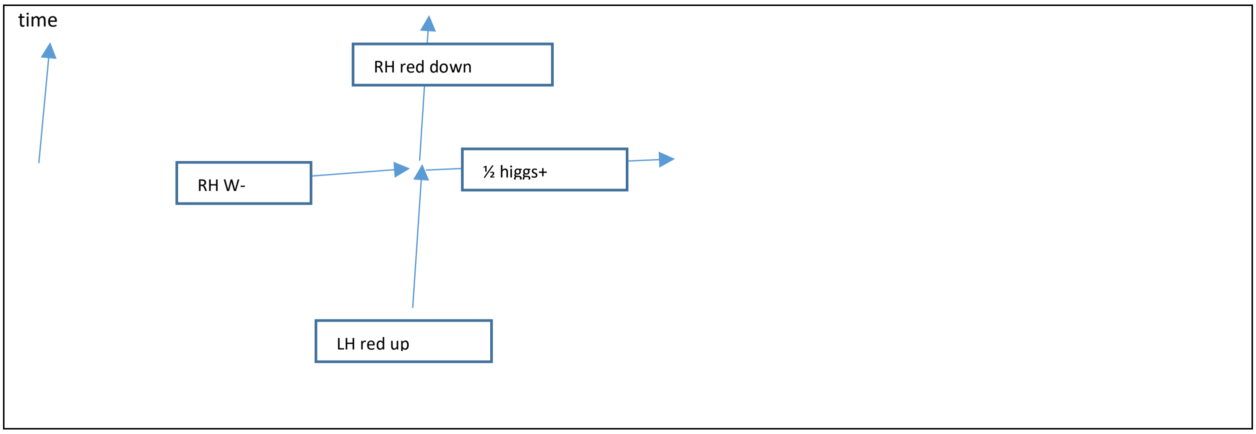
(2/3, -0.5, 0.5, red) + (-1, 1, 0) -> (-1/3, 0.5, 0, red) + (0, 0, 0.5)

E' Cr C'g' C'b' x^1 + BBx^3 -> B C'g' Cr C'b' x^1 + BE'x^3

Parentheses are: (electric charge, spin, weak isospin, QCD colour).

(See Figure D.)

Figure D The conversion of a LH red up quark to a RH red down quark



The conversion of a LH red down quark to a RH blue down quark can be shown as:

LH red down + red'-blue gluon -> RH blue down + higgs-

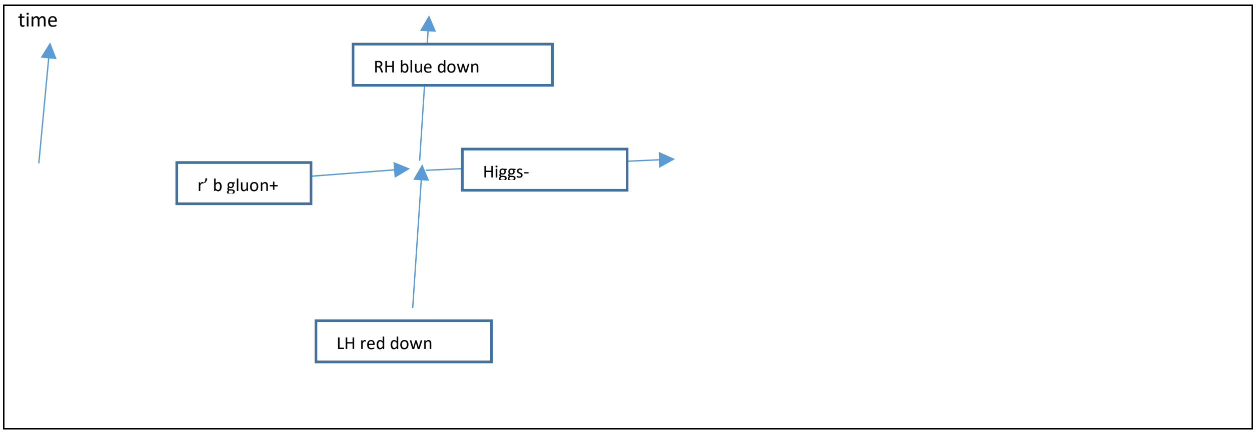
(-1/3, -0.5, -0.5, red) + (0, 1, 0, r'b) -> (-1/3, 0.5, 0, blue) + (0, 0, -0.5)

A Cr C'g' C'b' x^1 + BBC'C' x^5 Cg C'r' Cb C'g' C'r' Cb -> B C'g' C'r'Cb x^1 + ABC'C'x^6

Parentheses are: (electric charge, spin, weak isospin, colour).

(See Figure E.)

Figure E The conversion of a LH red down quark to a RH blue down quark



This interaction uses a colour zero higgs, whereas it is possible, alternatively, to arrange for a coloured higgs to be outgoing from the interaction. For example:

LH red down + red'-green gluon -> RH blue down + green-blue' higgs-

In the next section there will be a role for the QCD-colour zero 'gluon' as a graviton. This is the 'gluon' that is not allowed in SU(3) QCD because it has zero net QCD-colour, but it is easy to assemble a preon structure for one to use as a graviton.

Gravitational colour charges

In this preon model, the photon, Z, W and gluons form a family of bosons which are united in having the common property of spin 1. The photon has the fewest preons (4) and does not have its own net QCD colour. The Z and W each have more preons (8) than the photon but still has no net QCD colour. The gluon has more preons (16) and does have net QCD colour & anticolour. The fermions also reside in similar families with the division into the electron, neutrino, up and down quarks which have four preons. The muon generation has twelve preons and the tau generation has 20 preons (see Appendix II). This is a different kind of 'generation' than that defined in Figure A for unified force generations. The boson and fermion generations, such as electron, muon and tau, in model#8 are caused simply by aggregating different numbers of preons per particle per family. In neither case is the number of generations expected to be closed in model#8.

In model#8, gravitational force is implemented by spin 1 bosons and is a weaker version of QCD, QED and Weak forces. Spin 2 is eschewed in model#8. General Relativity operates at the macro level in which mass is always a positive charge. The graviton is normally assigned spin 2 in order to enable it to operate on macro masses and that equates to the tensor calculus used in GR. The tensor calculus is necessary in GR because positive mass is used as a charge. However, macro mass as a fundamental charge is an oddity at the level of elementary particles and even more so in preon model#8 where mass is not even included in the model as a fundamental quality. Model #8 can is used to build all known particle interactions keeping track of possible exchanges of preons and only requiring spin 1 gauge bosons as intermediaries of forces acting on colour charges and on black and white aggregates of colour charges. Introducing spin 2 gravitons into particle level theories, as was done in model#7, to match GR requirements seems to have been a retrograde step and is corrected in model#8 which uses spin 1 gravitons.

There are three points to consider about gravitational charge. First, how does the gravitational charge fit into the hexark? Second, there is the well-known problem of counterbalancing infinities (of mass) in preon models and, third, there is the role played by gravi-colour in preons and elementary particles.

Hexarks to cater for all forces

The three generations of forces in Figure A look superficially like a fractal pattern but physics forces arise from broken symmetries and any break of symmetry undermines a fractal pattern. Gravitation and QCD/QED forces are operating on the same particles with probably accompanying interactions of effects. So the role of gravitons in the prevailing situation where strong QCD forces group matter into atoms could be quite different from a scenario in which gravitation acted alone. This stops one being overconfident in identifying too closely gravitation with QCD/QED patterns. There is also the very strong hexacharge force within the preons and because very little can be deduced about that force it is assumed, with very little guidance available, that hexacharge forces do not overlap with QCD/QED forces. Model#8, however, only uses one set of hexarks and all charges, including hexacharge, must be carried by these hexarks.

Hexarks have the following properties: hexacharges (**R, G, B, R’, G’** or **B’**), QCD charges (r, g, b, r’, g’ or b’), gravitational charges ($\mathcal{R}$, $\mathcal{G}$, $\mathcal{B}$, $\mathcal{R}'$, $\mathcal{G}'$ or $\mathcal{B}'$), spin and weak isospin. Electric charge from QED is not included separately because it is determined exactly by QCD colour charge below the level of elementary particle. Weak isospin is also electric charge and is included only because the nature of its use in the higgs field is different from its use in QED.

The photon requires a gravitational attraction to nuclei as known from the effect of gravitational lensing. There is no such attractive effect for the photon in QCD nor QED so that is a break in fractal pattern between gravitation and QCD/QED. To obtain the required attraction it is necessary to let the photon have net gravi-colour or even net gravi-colour-anticolour. To do this requires hexarks to have forms such as (- - r $\mathcal{R}$ $\mathcal{G}'$ $\mathcal{B}'$ **G**), where $\mathcal{R}$ is gravi-red. The photon would have, say, net properties (0, 1, 0, 0, 𝒬𝒢′, 𝟎) where the properties are (electric charge, spin, weak isospin, QCD colour charge, gravi-colour charge, hexacolour charge). The gravi-colour would not affect the zero rest mass of the photon as the gluon also has zero rest mass and has QCD-colour-anticolour. The electrons and quarks could each have a single gravi-colour. The quark gravi-colour need not be the same colour as its QCD colour. The LH electrons could have properties (-1, -0.5, -0.5, 0, 𝒬 {or 𝒢 or ℬ or 𝒬′ or 𝒢′ or ℬ′}, 0). The RH down quarks could have the properties (-1/3, +0.5, 0, 0, 𝒬 {or 𝒢 or ℬ or 𝒬′ or 𝒢′ or ℬ′}, 0). The gluons could have the properties: (0, -1, 0, rg′, 𝒬𝒢′ ℬ𝒬′ 𝒢ℬ′ 𝒢𝒬′, 𝟎) where in keeping with the extra loading of gravi-colour there is more gravi-colour than QCD colour within the gluon. At this point it should be noted that (0, 1, 0, 0, 𝒬𝒢′ ℬ𝒬′ 𝒢ℬ′ 𝒢𝒬′ , 0) should be considered to be a graviton with no QCD function but with a definite gravitational function of attracting quarks over a greater distance than the QCD-active gluon. It is not clear to the author if a QCD-active gluon could range over a great distance, say to attract nuclei between earth and moon.

An example of a hexark is (- - r 𝒬 𝒢′ ℬ′ **G**) which has spin '-', weak isospin '-', red QCD charge, 𝒬 𝒢′ ℬ′ gravi-charge and **G** hexacharge. There are 864 (=2*2*6*6*6) such hexarks. These hexarks aggregate into preons. There are only four preons (plus four antipreons) in model#8 which cater entirely for all QCD, Weak and QED elementary particles. The same four preons can also cater as the basis for gravitational functions, but with gravi-coloured versions of each preon. There may be more preons required for the hexacharge functions but those functions are not considered here. If the hexacharge properties are discounted then there are 146 (= 2*2*6*6) different hexarks.

Gravitational interactions

Here are two examples of gravitational attraction: photon to quark and quark to quark.

First, photon to quark:
Photon- + graviton+ -> photon+ + graviton-
(0, -1, 0, 0, 𝒬𝒢′ ℬ𝒬′) + (0, 1, 0, 0, 𝒬𝒢′ 𝒢𝒬′ 𝒬𝒢′ 𝒢𝒬′) ->
(0, 1, 0, 0, 𝒬𝒢′ 𝒢𝒬′) + (0, -1, 0, 0, 𝒬𝒢′ 𝒢𝒬′ 𝒬𝒢′ ℬ𝒬′)

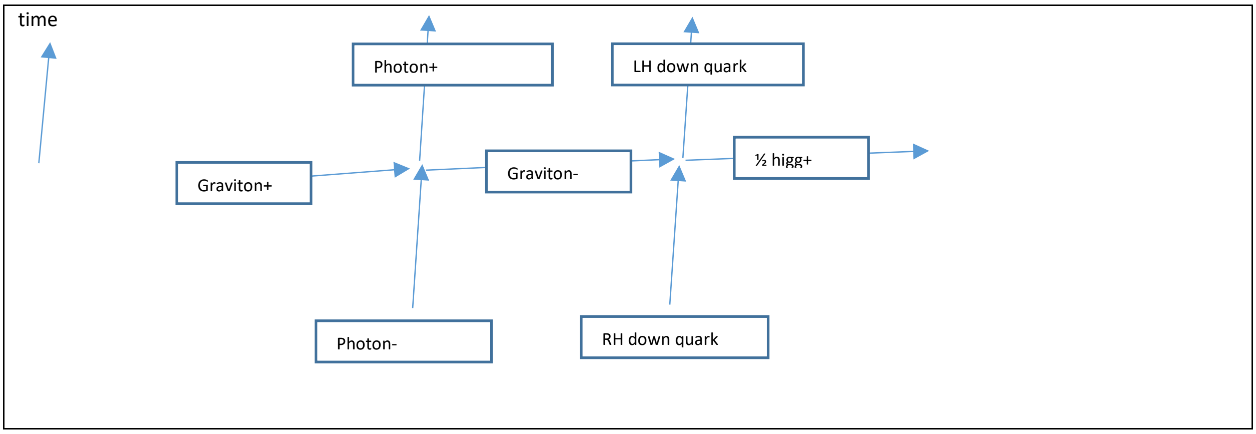
The outgoing graviton then interacts with a RH down quark as follows:
Graviton- + RH down 𝒢 quark -> higgs+ + LH down 𝒬 quark
(0, -1, 0, 0, 𝒬𝒢′ 𝒢𝒬′ 𝒬𝒢′ ℬ𝒬′) + (-1/3, 0.5, 0, red, 𝒢) ->

(0, 0, 0.5, 0, 𝒬𝒢′ 𝒢𝒬′ 𝒢𝒢′ ℬ𝒬′) + (-1/3, -0.5, -0.5, red, 𝒬)

(electric charge, spin, weak isospin, QCD colour, gravi-colour)

The photon changes both its spin and gravi-colour in the interaction while the quark also changes both spin and gravi-colour but not its QCD colour. Note that a 16-preon higgs with gravi-colour is outgoing from the interaction. Higgs with gravi-colours but zero QCD colour properties can participate in gravitation without getting drawn into interactions which exchange QCD-colour. (Figure F.)

Figure F The exchange of a graviton between a photon and a quark



Second, quark to quark gravitational attraction in two interactions is shown (Figure G):

Interaction 1 is:

Higgs+ + LH up 𝓑 quark -> graviton- + RH up 𝓡 quark
(0, 0, 0.5, 0, 𝓡𝓖′ 𝓑𝓡′ 𝓖𝓑′ 𝓖𝓡′) + (2/3, -0.5, 0.5, r, 𝓑) ->
(0, -1, 0, 0, 𝓑𝓖′ 𝓑𝓡′ 𝓖𝓑′ 𝓖𝓡′) + (2/3, 0.5, 0, r, 𝓡)

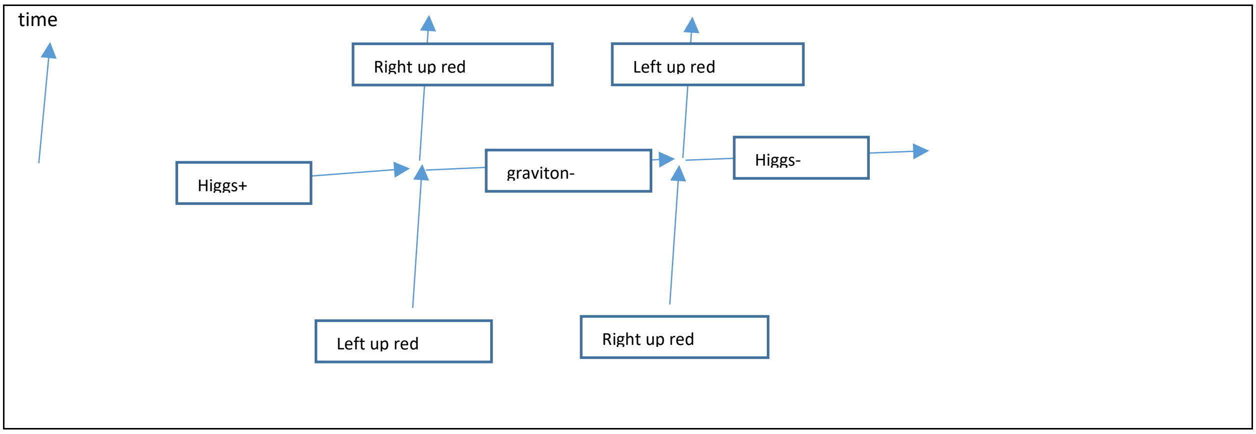
Interaction 2 is:

Graviton- + RH up 𝓖 quark -> higgs- + LH up 𝓑 quark
(0, -1, 0, 0, 𝓑𝓖′ 𝓑𝓡′ 𝓖𝓑′ 𝓖𝓡′) + (2/3, 0.5, 0, b, 𝓖) ->
(0, 0, -0.5, 0, 𝓑𝓖′ 𝓖𝓡′ 𝓖𝓑′ 𝓖𝓡′) + (2/3, -0.5, 0.5, b, 𝓑)

(electric charge, spin, weak isospin, QCD colour, gravi-colour)

In these gravitational attractions between two quarks, the graviton is a virtual particle and Figure G shows that the higgs acts like a catalyst and changes into the graviton and back again at the two interactions. Unlike a true catalyst, the higgs does change gravi-colour and weak isospin value in the process. The two quarks change handedness at the interactions. They also change gravi-colour but do not change QCD-colour. They also change weak isospin value which is absorbed by the higgs.

Figure G The exchange of a graviton between two red up quarks



The hexark in Model#8 is also required to carry the very strong hexacharge for force interactions within the preons. As the QCD functionality was switched off in gravitational examples above, so the hexa-charge needs to be switched off to grey or net zero in elementary particles, by aggregation of preons, but to be net black or white for preons, by aggregation of hexarks. For the gluons and higgs above, switching off functionality is done by setting QCD charge at zero. That means setting charge to zero or GREY or an equal mixture of BLACK and WHITE or an equal mixture of **R, G, B, R', G'** and **B'**, which are all the same thing expressed in different ways. A LH electron functioning within QED could have the following properties: (-1, -0.5, -0.5, 0, Ꞵ, 0) where the final zero is complete neutrality of hexacharge, and where the parentheses are (electric charge, spin, weak isospin, QCD colour, gravicolour, hexacolour) Any unknown particle operating within the preon could have an imbalance of hexacharge such as **R** for a fermion and say **BG'** for a boson. Setting to zero in an exact balance after an aggregation of colour charges is probably why infinites (of mass) can cancel out in particle physics. Mass is not a fundamental property of a preon and mass is energy which can be positive or negative, for example binding energy, so that difficulties in cancelling infinities is not with finality a reason to avoid methods which require such cancelling of infinities.

Preon properties with respect to gravitational colour charge

For QCD colour charge, only the sub-preons Cr, Cg, Cb, C'r', C'g' and C'b' have an imbalance of QCD colour. That is because the C preon has no spin or weak isospin which makes sub-division simple as it does not involve sub-division of spin or weak isospin. All preons, though, are either white (negative) or black (positive) with respect to QED charge. Gravi-colour is available plentifully in the hexarks and QCD colour is available independently of gravi-colour, that is the Cr sub-preon could also carry any of 𝓡 or 𝓖 or 𝓑 or 𝓡' or 𝓖' or 𝓑' gravi-charges. Further, the C preon could carry, say, 𝓡 and 𝓖' and 𝓑' making it net gravi-red whilst being only white for QED. So, for example, the LH electron which has four preons, say ACBB', can obtain gravi-charge from the C preon. The spin -1 photon has preons B'B'CC and can obtain gravi-colour and anticolour from the C preons.

Conclusion

This preon model has slowly evolved and, up to model#6, was originally concerned only with QCD, QED and Weak particles and their interactions. Model#7 extended the model by including spin 2 gravitons which have been withdrawn in model#8 and replaced by spin 1 gravitons. Spin 2 gauge bosons correspond to tensorial effects and could dovetail into a GR approach which is why they featured in model#7. GR is, however, a macro solution ignorant of knowing the true source of gravitational charge at micro level. The reason for the change towards spin 1 gravitons was the realisation that spin 1 gravitons plus a unified use of colour charge can unite the forces of QCD, QED, Weak and gravitation in a way that seems to contain an insight into the commonality of all charges (Figure 1). This commonality is outside the range of the Standard Model as there is a symmetry at the level of preons which is broken by aggregation of preons into elementary particles. At the preon level, the QED charge on preons derives exactly from the QCD charge. Because of aggregation of preons into quarks, that symmetry is broken at the level of quarks. A red quark can be either positive or negatively charged which hides the symmetry present at the level of preons.

The aggregation of very strong but opposing hexacharges within the preons, active in QCD and QED, makes them have zero or GREY hexacharge which hints at exactly balanced or cancelled 'infinites' (or very large quantities). Similarly, for a 'gluon' to be active outside the atom in the role of a graviton it probably need to have zero QCD colour charge. This gives a role as a graviton to the rr'gg'bb' 'non-gluon' not used as a ninth gluon in the Standard Model.

References

Fearnley, A.J. (November 2015) "Hexark and Preon Model #7: for Standard Model Elementary Particles, Higgs, Gravitons, Dark Energy and Dark Matter". vixra.org/abs/ 1511.0115

Fearnley, A.J. (May 2015) "*Hexark and Preon Model #6: the Building Blocks of Elementary Particles. Electric Charge is Determined by Hexatone and Gives a Common Link Between QED and QCD*". vixra.org/abs/1505.0076

Fearnley, A.J. (October 2015) "*Models for quantum gravity, dark matter and dark energy using the Hexark and Preon Model #7*". vixra.org/abs/1510.0338

Fearnley, A.J. (2 September 2017) "*Hexark and Preon Model #8 and the Unification of Forces: a Summary".* vixra.org/abs/1709.0021

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APPENDIX I

Tables of the hexarks contained in the four neutral-colour preons: A, B, C and E and in their 'antimatter' versions: A', B', C' and E'

A hexark's electric charge is + or - 1/24; A hexark's spin is + or - 1/24; A hexark's weak isospin is + or - 1/24. A hexark's hexatone is also + or - 1/24: r, g and b each have hexatone = -1/24 and r', g' and b' each have hexatone = +1/24. Electric charge for the preons is determined exactly by colour (negative electric charge) and anticolour (positive electric charge). These hexarks cater for QCD, Weak and QED only. That is for simplicity. A full table would include gravi-charges [which would boost the number of hexarks to 146] and hexacharges [which would take the total to 864].

Table A: Preon Unit A: 12 hexarks
Total electric charge is -1/2; total spin -1/2; and total weak isospin -1/2;
total hexatone is - 1/2.

(spin, weak isospin and QCD colour, respectively)

- - r	- - r	- - r	- - r
- - g	- - g	- - g	- - g
- - b	- - b	- - b	- - b

Table B: Preon Unit B: 12 hexarks
Total electric charge is -1/2; total spin +1/2; and total weak isospin is zero;
total hexatone is -1/2.

+ - r	+ + r	+ - r	+ + r
+ - g	+ + g	+ - g	+ + g
+ - b	+ + b	+ - b	+ + b

Table C: Preon Unit C: 12 hexarks
Total electric charge is -1/2; total spin is zero; and total weak isospin is zero;
total hexatone is -1/2.

- - r	- + r	+ - r	+ + r
- - g	- + g	+ - g	+ + g
- - b	- + b	+ - b	+ + b

Table E: Preon Unit E: 12 hexarks
Total electric charge is -1/2; total spin is 1/2; and total weak isospin is -1/2; total hexatone is -1/2.

+ - r	+ - r	+ - r	+ - r
+ - g	+ - g	+ - g	+ - g
+ - b	+ - b	+ - b	+ - b

Table A': Preon Unit A': 12 antihexarks
Total electric charge is +1/2; total spin +1/2; and total weak isospin +1/2; total hexatone is +1/2.

+ + r'	+ + r'	+ + r'	+ + r'
+ + g'	+ + g'	+ + g'	+ + g'
+ + b'	+ + b'	+ + b'	+ + b'

Table B': Preon Unit B': 12 antihexarks
Total electric charge is +1/2; total spin -1/2; and total weak isospin is zero; Total hexatone is +1/2.

- - r'	- + r'	- - r'	- + r'
- - g'	- + g'	- - g'	- + g'
- - b'	- + b'	- - b'	- + b'

Table C': Preon Unit C': 12 antihexarks
Total electric charge is +1/2; total spin is zero; and total weak isospin is zero; total hexatone is +1/2.

- - r'	- + r'	+ - r'	+ + r'
- - g'	- + g'	+ - g'	+ + g'
- - b'	- + b'	+ - b'	+ + b'

Table E': Preon Unit E': 12 antihexarks
Total electric charge is +1/2; total spin is -1/2; and total weak isospin is +1/2; total hexatone is +1/2.

- + r'	- + r'	- + r'	- + r'
- + g'	- + g'	- + g'	- + g'
- + b'	- + b'	- + b'	- + b'

Tables of the hexarks contained in the three colour sub-units: Cr, Cg and Cb and in their ‘antimatter’ versions: C’r’, C’g’ and C’b’

(spin, weak isospin and QCD colour, respectively)

Table Cr: Preon Cr: 4 red hexarks
Total electric charge is -1/6; total spin is zero; and total weak isospin is zero; total hexatone is -1/6.

- - r   - + r   + - r   + + r

Table Cg: Preon Cg: 4 green hexarks
Total electric charge is -1/6; total spin is zero; and total weak isospin is zero; total hexatone is -1/6.

- - g   - + g   + - g   + + g

Table Cb: Preon Cb: 4 blue hexarks
Total electric charge is -1/6; total spin is zero; and total weak isospin is zero; total hexatone is -1/6.

- - b   - + b   + - b   + + b

Table 3C’r’: Preon C’r’: 4 antired hexarks
Total electric charge is +1/6; total spin is zero; and total weak isospin is zero; total hexatone is +1/6.

- - r’   - + r’   + - r’   + + r’

Table C’g’: Preon C’g’: 4 antigreen hexarks
Total electric charge is +1/6; total spin is zero; and total weak isospin is zero; total hexatone is +1/6.

- - g’   - + g’   + - g’   + + g’

Table C’b’: Preon C’b’: 4 antiblue hexarks
Total electric charge is +1/6; total spin is zero; and total weak isospin is zero; total hexatone is +1/6.

- - b’   - + b’   + - b’   + + b’

APPENDIX II

Elementary particles as combinations of preons and sub-preons

Tables 1 to 8 show combinations of preons and sub-preons forming all the Standard Model particles, the higgs and dark bosons.

The four-unit combinations are the smallest combinations which allow for the photon and higgs particles and the four-unit block is taken here as the smallest form of any elementary particle. For example a left-handed electron could be ACAA’ or ACBB’ or ACCC’ or ACEE’ where AA’, BB’, CC’ and EE’ act as neutral bulk fillers. This means that not every electron is identical and could imply that not every electron is equally likely to be able to participate in an interaction.

Neutral pairs of preon and antipreon are also important to the preon model as they form neutral building blocks which are the only difference between similar particles in different generations, for example electron and muon.

Table 1: Four preons (electron, photon, neutrino and ¼ higgs)

Preon units	Electric charge	Spin	Weak isospin	Particle name
ACx^1	-1	-0.5	-0.5	LH electron
BCx^1	-1	0.5	0	RH electron
A'C'x^1	1	0.5	0.5	RH positron
B'C'x^1	1	-0.5	0	LH positron
CE’x^1	0	-0.5	+0.5	LH neutrino
BC'x^1	0	0.5	0	RH sterile neutrino
C’Ex^1	0	0.5	-0.5	RH antineutrino
B'Cx^1	0	-0.5	0	LH sterile antineutrino
B’B’CC or AE’ x^1	0	-1	0	Photon
BBC'C' or A’E x^1	0	1	0	Photon
non-Standard Model				
x^2	0	0	0	Neutral (dark) boson
ABC’C’ or B’Ex^1	0	0	-0.5	Higgs-like particle (1/4 higgs)
A’B’CC or BE’x^1	0	0	+0.5	Higgs-like particle (1/4 higgs)

where x^1=any one of four pairs: AA’ or BB’ or CC’ or EE’
and where x^2= any two pairs from AA’ or BB’ or CC’ or E’, for example AA’AA’ or AA’EE’

The higher generations of particles use the above basic forms of the first generation with the addition of neutral pairs of preon units. Quark forms are given in Tables 6 to 8.

Table 2: Eight preons (Z, W and ½ higgs)

Preons	Electric charge	Spin	Weak isospin	Particle name
AAx^3	-1	-1	-1	LH W-
$A'A'x^3$	1	1	1	RH W+
BBx^3	-1	1	0	RH W-
$B'B'x^3$	1	-1	0	LH W+
$B'B'CCx^2$ or $AE'x^3$	0	-1	0	Z
$BBC'C'x^2$ or $A'Ex^3$	0	1	0	Z
non-Standard Model				
x^4	0	0	0	neutral (dark) boson
$ABC'C'x^2$ or $B'Ex^3$	0	0	-0.5	Higgs-like particle (1/2 higgs)
$A'B'CCx^2$ or $BE'x^3$	0	0	0.5	Higgs-like particle (1/2 higgs)

where x^2 = any two pairs of preons from AA' or BB' or CC' or EE', for example AA'AA' or AA'BB' or BB'EE'
where x^3 = any three pairs of preons from AA' or BB' or CC' or EE', for example AA'AA'BB' or AA'BB'CC'
where x^4 = any four pairs of preons from AA' or BB' or CC' or EE', for example AA'EE'BB'CC'

Table 3: Twelve preons (muon and muon neutrino)

Preons	Electric charge	Spin	Weak isospin	Particle name
ACx^5	-1	-0.5	-0.5	LH muon-
BCx^5	-1	0.5	0	RH muon-
$CE'x^5$	0	-0.5	0.5	LH muon neutrino
$B'Cx^5$	0	-0.5	0	LH sterile muon antineutrino
$BC'x^5$	0	0.5	0	RH sterile muon neutrino
$C'Ex^5$	0	0.5	-0.5	RH muon antineutrino

B'C'x^5	1	-0.5	0	LH muon+
A'C'x^5	1	0.5	0.5	RH muon+
non-Standard Model				
x^6	0	0	0	Neural (dark) boson
ABC'C' x^4 or B'Ex^5	0	0	-0.5	Higgs-like particle (3/4 higgs)
A'B'CC x^4 or BE'x^5	0	0	+0.5	Higgs-like particle (3/4 higgs)

where x^n = any n pairs of preons from AA' or BB' or CC' or EE'

Table 4: Sixteen preons (gluon, Higgs and dark)

Preons[1, 2, 3]	Electric charge	Spin	Weak isospin	Particle name
B'B'CC x^5 C'g' Cr C'b' Cg C'r' Cb	0	-1	0	gluon (rr')
BBC'C' x^5 C'g' Cr C'b' Cg C'r' Cb	0	1	0	gluon (rr')
B'B'CC x^5 Cg C'r' C'b' C'g' Cr Cb	0	-1	0	gluon (gg')
BBC'C' x^5 Cg C'r' C'b' C'g' Cr Cb	0	1	0	gluon (gg')
B'B'CC x^5 C'g' C'r' Cb Cg Cr C'b'	0	-1	0	gluon (bb')
BBC'C' x^5 C'g' C'r' Cb Cg Cr C'b'	0	1	0	gluon (bb')
B'B'CC x^5 C'g' Cr C'b' C'g' Cr Cb	0	-1	0	gluon (rg')
BBC'C' x^5 C'g' Cr C'b' C'g' Cr Cb	0	1	0	gluon (rg')
B'B'CC x^5 C'g' Cr C'b' Cg Cr C'b'	0	-1	0	gluon (rb')
BBC'C' x^5 C'g' Cr C'b' Cg Cr C'b'	0	1	0	gluon (rb')
B'B'CC x^5 Cg C'r' C'b' Cg Cr C'b'	0	-1	0	gluon (gb')
BBC'C' x^5 Cg C'r' C'b' Cg Cr C'b'	0	1	0	gluon (gb')
B'B'CC x^5 Cg C'r' Cb Cg C'r' C'b'	0	-1	0	gluon (r'g)
BBC'C' x^5 Cg C'r' Cb Cg C'r' C'b'	0	1	0	gluon (r'g)
B'B'CC x^5 Cg C'r' Cb C'g' C'r' Cb	0	-1	0	gluon (r'b)
BBC'C' x^5 Cg C'r' Cb C'g' C'r' Cb	0	1	0	gluon (r'b)
B'B'CC x^5 C'g' Cr Cb C'g' C'r' Cb	0	-1	0	gluon (g'b)
BBC'C' x^5 C'g' Cr Cb C'g' C'r' Cb	0	1	0	gluon (g'b)
non-Standard Model				
ABC'C'x^5 C'g' Cr C'b' Cg C'r' Cb	0	0	-0.5	Higgs (rr')
A'B'CCx^5 C'g' Cr C'b' Cg C'r' Cb	0	0	0.5	Higgs (rr')
ABC'C'x^5 Cg C'r' C'b' C'g' Cr Cb	0	0	-0.5	Higgs (gg')
A'B'CCx^5 Cg C'r' C'b' C'g' Cr Cb	0	0	0.5	Higgs (gg')
ABC'C'x^5 C'g' C'r' Cb Cg Cr C'b'	0	0	-0.5	Higgs (bb')
A'B'CCx^5 C'g' C'r' Cb Cg Cr C'b'	0	0	0.5	Higgs (bb')
ABC'C'x^5 C'g' Cr C'b' C'g' Cr Cb	0	0	-0.5	Higgs (rg')
A'B'CCx^5 C'g' Cr C'b' C'g' Cr Cb	0	0	0.5	Higgs (rg')
ABC'C'x^5 C'g' Cr C'b' Cg Cr C'b'	0	0	-0.5	Higgs (rb')

A’B’CCx^5 C'g' Cr C'b' Cg Cr C’b’	0	0	0.5	Higgs (rb’)
ABC’C’x^5 Cg C’r’ C'b' Cg Cr C’b’	0	0	-0.5	Higgs (gb’)
A’B’CCx^5 Cg C’r’ C'b' Cg Cr C’b’	0	0	0.5	Higgs (gb’)
ABC’C’x^5 Cg C’r’ Cb Cg C’r’ C’b’	0	0	-0.5	Higgs (r’g)
A’B’CCx^5 Cg C’r’ Cb Cg C’r’ C’b’	0	0	0.5	Higgs (r’g)
ABC’C’x^5 Cg C’r’ Cb C’g’ C’r’ Cb	0	0	-0.5	Higgs (r’b)
A’B’CCx^5 Cg C’r’ Cb C’g’ C’r’ Cb	0	0	0.5	Higgs (r’b)
ABC’C’x^5 C'g' Cr Cb C’g’ C’r’ Cb	0	0	-0.5	Higgs (g’b)
A’B’CCx^5 C'g' Cr Cb C’g' C’r’ Cb	0	0	0.5	Higgs (g’b)
‘Darkons’ (dark bosons):				
x^7 C'g' Cr C'b' Cg C’r’ Cb	0	0	0	Dark (rr’)
x^7 Cg C’r’ C'b' C’g’ Cr Cb	0	0	0	Dark (gg’)
x^7 C’g’ C’r’ Cb Cg Cr C’b’	0	0	0	Dark (bb’)
x^7 C'g' Cr C'b' C’g’ Cr Cb	0	0	0	Dark (rg’)
x^7 C'g' Cr C'b' Cg Cr C’b’	0	0	0	Dark (rb’)
x^7 Cg C’r’ C'b' Cg Cr C’b’	0	0	0	Dark (gb’)
x^7 Cg C’r’ Cb Cg C’r’ C’b’	0	0	0	Dark (r’g)
x^7 Cg C’r’ Cb C’g’ C’r’ Cb	0	0	0	Dark (r’b)
x^7 C’g’ Cr Cb C’g’ C’r’ Cb	0	0	0	Dark (g’b)

[1] *The gluon has two alternative methods of construction. For the alternative method, replace B'B'CCx^5 by AE’x^6 in the LH spin forms and replace BBC'C'x^5 by A’Ex^6 in the RH spin forms.*

[2] *The higgs has two alternative methods of construction. For the alternative method, replace ABC’C’x^6 by B’Ex^7 in the LH spin forms and replace A’B’CCx^6 by BE’x^7 in the RH spin forms.*
where X^n = any n pairs of preons from AA’ or BB’ or CC’ or EE’.

For properties of gravitons see the section: ‘Gravitational interactions’.
A graviton could have the following properties: (0, 1, 0, 0, RG’ GR’ RG’ GR’, 0)
Where parentheses are:
(electric charge, spin, weak isospin, QCD colour, gravi-colour, hexacolour)
To show a possible preon content, take a gluon and change it to have zero QCD-colour by using the form:
X^4 CC’CC’CC’CC’. This form has net zero QCD colour charge but can have RG’ GR’ RG’ GR’ net gravi-colour charge via the CC’CC’CC’CC’ part of the graviton, as C can have a net gravi-colour.

Table 5: Twenty preons (tau and tau neutrino)

Preons	Electric charge	Spin	Weak isospin	Particle name
ACx^9	-1	-0.5	-0.5	LH tau-
BCx^9	-1	0.5	0	RH tau-
$B'Cx^9$	0	-0.5	0	LH tau sterile antineutrino
$BC'x^9$	0	0.5	0	RH tau sterile neutrino
$C'Ex^9$	0	0.5	-0.5	RH tau antineutrino
$CE'x^9$	0	-0.5	0.5	LH tau neutrino
$B'C'x^9$	1	-0.5	0	LH tau+
$A'C'x^9$	1	0.5	0.5	RH tau+
non-Standard Model				
x^{10}	0	0	0	neutral (dark) boson *
$ABC'C'\ x^8$ or $B'Ex^9$	0	0	-0.5	Higgs-like particle (5/4 higgs) *
$A'B'CC\ x^8$ or $BE'x^9$	0	0	+0.5	Higgs-like particle (5/4 higgs) *

where x^n = any n pairs of preons from AA’ or BB’ or CC’ or EE’.

** These particles, in this generation, will have colour-anticolour forms.*

Table 6: Three hexacolour sub-preons plus three preons (up quark and down quark)

Preons and sub-preons	Electric charge	Spin	Weak isospin	Particle Colour	Particle name
B’ C C C’r’ Cg Cb	-2/3	-0.5	0	r'	LH antiup
B’ C C Cr C’g’ Cb	-2/3	-0.5	0	g'	LH antiup
B’ C C Cr Cg C’b’	-2/3	-0.5	0	b'	LH antiup
E C’r’ Cg Cb x^1	-2/3	0.5	-0.5	r'	RH antiup
E Cr C’g’ Cb x^1	-2/3	0.5	-0.5	g'	RH antiup
E Cr Cg C’b’ x^1	-2/3	0.5	-0.5	b'	RH antiup
A C'g' Cr C'b' x^1	-1/3	-0.5	-0.5	r	LH down
A Cg C'r' C'b' x^1	-1/3	-0.5	-0.5	g	LH down
A C'g' C'r' Cb x^1	-1/3	-0.5	-0.5	b	LH down
B C'g' Cr C'b' x^1	-1/3	0.5	0	r	RH down
B Cg C'r' C'b' x^1	-1/3	0.5	0	g	RH down
B C'g' C'r' Cb x^1	-1/3	0.5	0	b	RH down
B' Cg Cb C'r' x^1	1/3	-0.5	0	r'	LH antidown

B' C'g' Cb Cr x^1	1/3	-0.5	0	g'	LH antidown
B' Cg C'b' Cr x^1	1/3	-0.5	0	b'	LH antidown
A' Cg Cb C'r' x^1	1/3	0.5	0.5	r'	RH antidown
A' C'g' Cb Cr x^1	1/3	0.5	0.5	g'	RH antidown
A’ Cg Cr C'b' x^1	1/3	0.5	0.5	b'	RH antidown
E’ Cr C’g’ C’b’ x^1	2/3	-0.5	0.5	r	LH up
E’ C’r’ Cg C’b’ x^1	2/3	-0.5	0.5	g	LH up
E’ C’r’ C’g’ Cb x^1	2/3	-0.5	0.5	b	LH up
B C’ C’ Cr C’g’ C’b’	2/3	0.5	0	r	RH up
B C’ C’ C’r’ Cg C’b’	2/3	0.5	0	g	RH up
B C’ C’ C’r’ C’g’ Cb	2/3	0.5	0	b	RH up

where x^1 = any one pair of preons from AA’ or BB’ or CC’ or EE’.

Table 7: Three hexacolour sub-preons plus eleven preons (charm quark and strange quark)

Preons and sub-preons	Electric charge	Spin	Weak isospin	Particle Colour	Particle name
B’ C C C’r’ Cg Cb X^4	-2/3	-0.5	0	r'	LH anticharm
B’ C C Cr C’g’ Cb X^4	-2/3	-0.5	0	g'	LH anticharm
B’ C C Cr Cg C’b’ X^4	-2/3	-0.5	0	b'	LH anticharm
E C’r’ Cg Cb X^5	-2/3	0.5	-0.5	r'	RH anticharm
E Cr C’g’ Cb X^5	-2/3	0.5	-0.5	g'	RH anticharm
E Cr Cg C’b’ X^5	-2/3	0.5	-0.5	b'	RH anticharm
A C'g' Cr C'b' X^5	-1/3	-0.5	-0.5	r	LH strange
A Cg C'r' C'b' X^5	-1/3	-0.5	-0.5	g	LH strange
A C'g' C'r' Cb X^5	-1/3	-0.5	-0.5	b	LH strange
B C'g' Cr C'b' X^5	-1/3	0.5	0	r	RH strange
B Cg C'r' C'b' X^5	-1/3	0.5	0	g	RH strange
B C'g' C'r' Cb X^5	-1/3	0.5	0	b	RH strange
B' Cg Cb C'r' X^5	1/3	-0.5	0	r'	LH antistrange
B' C'g' Cb Cr X^5	1/3	-0.5	0	g'	LH antistrange
B' Cg C'b' Cr X^5	1/3	-0.5	0	b'	LH antistrange
A' Cg Cb C'r' X^5	1/3	0.5	0.5	r'	RH antistrange
A' C'g' Cb Cr X^5	1/3	0.5	0.5	g'	RH antistrange
A' Cg C'b' Cr X^5	1/3	0.5	0.5	b'	RH antistrange
E’ Cr C’g’ C’b’ X^5	2/3	-0.5	0.5	r	LH charm
E’ C’r’ Cg C’b’ X^5	2/3	-0.5	0.5	g	LH charm
E’ C’r’ C’g’ Cb X^5	2/3	-0.5	0.5	b	LH charm
B C’ C’ Cr C’g’ C’b’ x^4	2/3	0.5	0	r	RH charm
B C’ C’ C’r’ Cg C’b’ x^4	2/3	0.5	0	g	RH charm
B C’ C’ C’r’ C’g’ Cb x^4	2/3	0.5	0	b	RH charm

where x^n = any n pairs of preons from AA’ or BB’ or CC’ or EE’.

Table 8: Three hexacolour sub-preons plus nineteen preons (top quark and bottom quark)

Preons and sub-preons	Electric charge	Spin	Weak isospin	Particle Colour	Particle name
B’ C C C’r’ Cg Cb x^8	-2/3	-0.5	0	r'	LH antitop
B’ C C Cr C’g’ Cb x^8	-2/3	-0.5	0	g'	LH antitop
B’ C C Cr Cg C’b’ x^8	-2/3	-0.5	0	b'	LH antitop
E C’r’ Cg Cb X^9	-2/3	0.5	-0.5	r'	RH antitop
E Cr C’g’ Cb X^9	-2/3	0.5	-0.5	g'	RH antitop
E Cr Cg C’b’ X^9	-2/3	0.5	-0.5	b'	RH antitop
A C'g' Cr C'b' X^9	-1/3	-0.5	-0.5	r	LH bottom
A Cg C'r' C'b' X^9	-1/3	-0.5	-0.5	g	LH bottom
A C'g' C'r' Cb X^9	-1/3	-0.5	-0.5	b	LH bottom
B C'g' Cr C'b' X^9	-1/3	0.5	0	r	RH bottom
B Cg C'r' C'b' X^9	-1/3	0.5	0	g	RH bottom
B C'g' C'r' Cb X^9	-1/3	0.5	0	b	RH bottom
B' Cg Cb C'r' X^9	1/3	-0.5	0	r'	LH antibottom
B' C'g' Cb Cr X^9	1/3	-0.5	0	g'	LH antibottom
B' Cg C'b' Cr X^9	1/3	-0.5	0	b'	LH antibottom
A' Cg Cb C'r' X^9	1/3	0.5	0.5	r'	RH antibottom
A' C'g' Cb Cr X^9	1/3	0.5	0.5	g'	RH antibottom
A' Cg C'b' Cr X^9	1/3	0.5	0.5	b'	RH antibottom
E’ Cr C’g’ C’b’ X^9	2/3	-0.5	0.5	r	LH top
E’ C’r’ Cg C’b’ X^9	2/3	-0.5	0.5	g	LH top
E’ C’r’ C’g’ Cb X^9	2/3	-0.5	0.5	b	LH top
B C’ C’ Cr C’g’ C’b’ x^8	2/3	0.5	0	r	RH top
B C’ C’ C’r’ Cg C’b’ x^8	2/3	0.5	0	g	RH top
B C’ C’ C’r’ C’g’ Cb x^8	2/3	0.5	0	b	RH top

where x^n = any n pairs of preons from AA’ or B