On the hierarchy of objects

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Last version: December 7, 2012

Abstract

The objects that occur in nature can be categorized in several levels. In this collection every level except the first level is built from lower level objects. This collection represents a simple model of nature. The model exploits the possibilities that mathematical concepts provide. Also typical physical ingredients will be used.

The paper splits the hierarchy of objects in a logic model and a geometric model. These two hierarchies partly overlap.

1 Introduction

I present you my personal view on the hierarchy of objects that occur in nature. Only the lowest levels are presented. This paper does not treat composite particle objects.

This hierarchy model is in concordance with the Hilbert Book Model[1]. Since the HBM is strictly based on the axioms of traditional quantum logic, the same will be the case for the logic part of the object hierarchy model. The Hilbert Book Model gets its name from the fact that traditional quantum logic can only represent a static status quo and for that reason dynamics must be represented by an ordered sequence of these static models. The similarity with a sequence of pages and a book is obvious.

The object hierarchy model adds two fundamental starting points. First, a correlation vehicle must provide the cohesion between the subsequent members of the sequence. Second, the model must obey the cosmological principle.

The cosmological principle means that at large scales, universe looks the same for whomever and wherever you are. One of the consequences is that at larger scales universe possesses no preferred directions.

This paper is part of the ongoing HBM project.

[1] http://vixra.org/abs/1209.0047

2 The logic model

2.1 Static status quo

2.1.1 Quantum logic

The most basic level of objects in nature is formed by the propositions that can be made about the objects that occur in nature. The relations between these propositions are restricted by the axioms of traditional quantum logic. This set of related propositions can only describe a static status quo.

In mathematical terminology the propositions whose relations are described by traditional quantum logic form a lattice. More particular, they form an orthomodular lattice that contains a countable infinite set of atomic (=mutually independent) propositions. Within the same quantum logic system multiple versions of sets of these mutually independent atoms exist.

Traditional quantum logic shows narrow similarity with classical logic, however the modular law, which is one of the about 25 axioms that define the classical logic, is weakened in quantum logic. This is the cause of the fact that the structure of quantum logic is significantly more complicated than the structure of classical logic.

2.1.2 Isomorphic model

In the third and fourth decade of the twentieth century Garret Birkhoff and John von Neumann were able to prove that for the set of propositions in the traditional quantum logic model a mathematical lattice isomorphic model exists in the form of the set of the closed subspaces of an infinite dimensional separable Hilbert space. The Hilbert space is a linear vector space that features an inner vector product. It offers a mathematical environment that is far better suited for the formulation of physical laws than what the purely logic model can provide.

Some decades later Constantin Piron proved that the only number systems that can be used to construct the inner products of the Hilbert vectors must be division rings. The only suitable division rings are the real numbers, the complex numbers and the quaternions[2]. Since the set of real numbers is multiple times contained in the set of complex numbers and the set of complex numbers is multiple times contained in the set of quaternions, the most extensive isomorphic model is contained in an infinite dimensional quaternionic separable Hilbert space. For our final model we will choose the quaternionic Hilbert space, but first we study what the real Hilbert space model and the complex Hilbert space model provide.

The set of closed subspaces of the Hilbert space represents the set of propositions that forms the static quantum logic system. The set of mutually independent atoms in the logic model corresponds to a set of base vectors that together span the whole Hilbert space. Like the sets of mutually independent atoms in the quantum logic system, multiple sets of orthonormal base vectors exist in the Hilbert space. The base vectors do not form an ordered set. However, a linear operator will have a set of eigenvectors that form a complete orthonormal base. The corresponding eigenvalues may provide a means for enumeration and

[2] Bi-quaternions have complex coordinate values and do not form a division ring.

thus for ordering these base vectors. The choice of the operator is arbitrary. Many suitable enumeration operators exist.

Together with the pure quantum logic model, we now have a dual model that is significantly better suited for use with calculable mathematics. Both models represent a static status quo.

2.2 Dynamic model

A dynamic model can be constructed from an ordered sequence of the above static models. Care must be taken to keep sufficient coherence between subsequent static models. However, some deviation must be tolerated, because otherwise, nothing dynamical will happen in this new dynamic model. The cohesion is established by a suitable correlation vehicle.

As a consequence, an ordered sequence of infinite dimensional quaternionic separable Hilbert spaces forms the isomorphic model of the dynamic logical model.

2.3 Affine space

The set of mutually independent atomic propositions is represented by an orthonormal set of base vectors in Hilbert space. Both sets span the whole of the corresponding structure. An arbitrary orthonormal base is not an ordered set. However, these base vectors can be enumerated. The enumeration may introduce an ordering. In that case the attachment of the numerical values of the enumerators to the Hilbert base vectors defines a corresponding operator. It must be remembered that the selection of the enumerators and therefore the corresponding ordering is kind of artificial. Both in the Hilbert space and in its Gelfand triple, the enumeration can be represented by a linear enumeration operator.

2.4 Continuity

The coherence between subsequent static models can be established by embedding each of the countable sets in a single reference continuum. For example the Hilbert space can be embedded in its Gelfand triple[3]. The enumerators of the base vectors of the separable Hilbert space can also be embedded in a corresponding continuum. That continuum is formed by the values of the enumerators that enumerate an orthonormal base of the Gelfand triple. We will reuse the same (reference) Gelfand triple for all members of the sequence of Hilbert spaces. The reference Gelfand triple is taken from the a selected[4] member of the sequence. Next a correlation vehicle is established by introducing a continuous distance function that controls the coherence between subsequent members of the sequence of static models. It does that by defining the interspacing in the countable set of the enumerators that act in the separable Hilbert space by mapping them to the reference continuum. In fact the differential of the distance function is used to specify the infinitesimal interspacing[5].

[3] See http://vixra.org/abs/1210.0111 for more details on the Hilbert space and the Gelfand triple.
[4] The selection criterion is that around this member the scaling of the imaginary space is a symmetric function of progression.
[5] The differential defines a local metric.

The distance function uses a combination of progression and the enumerator id as its parameter value. The value of the progression might be included in the value of the id. Apart from their relation via the distance function, the enumerators and the embedding continuum are mutually independent[6]. For the selected correlation vehicle it is useful to use numbers as the value of the enumerators. The type of the numbers will be taken equal to the number type that is used for specifying the inner product of the corresponding Hilbert space and Gelfand triple. The danger is then that a direct relation between the value of the enumerator of the Hilbert base vectors and the embedding continuum is suggested. So, here a warning is at its place. Without the distance function there is no relation between the value of the enumerators and corresponding values in the embedding continuum. However, there is a well-defined relation between the images[7] produced by the distance function and the embedding continuum that is formed by the corresponding enumerators in the Gelfand triple.[8]

The relation between the members of a countable set and the members of a continuum raises a serious one to many problem. That problem can easily be resolved for real Hilbert spaces and complex Hilbert spaces, but it requires a special solution for quaternionic Hilbert spaces.

Together with the reference continuum and the Hilbert base enumeration set the distance function defines the evolution of the model.

2.5 Hilbert spaces

2.5.1 Real Hilbert space model

When a real separable Hilbert space is used to represent the static quantum logic, then it is sensible to use a countable set of real numbers for the enumeration. A possible selection is formed by the natural numbers. Within the real numbers the natural numbers have a fixed interspacing. Since the rational number system has the same cardinality as the natural number system, the rational numbers can also be used as enumerators. In that case it is sensible to specify ***a smallest rational number*** as the enumeration step size. In this way the notion of interspacing is preserved and can the distance function do its scaling task[9]. In the realm of the real Hilbert space model, the continuum that embeds the enumerators is formed by the real numbers. The values of the enumerators of the Hilbert base vectors are used as parameters for the distance function. The value that is produced by the distance function determines the target location for the corresponding enumerator in the embedding continuum. This interspacing freedom is used in order to introduce dynamics in which something happens.

In fact what we do is defining an enumeration operator that has the enumeration numbers as its eigenvalues. The corresponding eigenvectors of this operator are the target of the enumerator.

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[6] This is not the case for the reference Hilbert space in the sequence. There a direct relation exists.
[7] Later these images will be called Qpatches
[8] We will take the reference continuum from the Gelfand triple of the reference Hilbert space in the sequence. Thus, in the reference member of the sequence a clear relation between the two enumeration sets exist.
[9] Later, in the quaternionic Hilbert space model, this freedom is used to introduce space curvature and it is used for resolving the one to many problem.

Instead of using a fixed smallest rational number as the enumeration step size and a map into a reference continuum we could also have chosen for a model in which the rational numbered step size varies with the index of the enumerator.

2.5.2 Gelfand triple

The Gelfand triple of a real separable Hilbert space can be understood via the corresponding enumeration model of the real separable Hilbert space. Let the smallest enumeration value of the rational enumerators approach zero. Even when zero is reached, then still the set of enumerators is countable. Now add all limits of converging rows of rational enumerators to the enumeration set. After this operation the enumeration set has become a continuum and has the same cardinality as the set of the real numbers. It means that also every orthonormal base of the Gelfand triple has that cardinality. It also means that linear operators in this space have eigenspaces that are continuums and have the cardinality of the real numbers[10].

2.5.3 Complex Hilbert space model

When a complex separable Hilbert space is used to represent quantum logic, then it is sensible to use rational complex numbers for the enumeration. Again a smallest enumeration step size is introduced. However, the imaginary fixed enumeration step size may differ from the real fixed enumeration step size. In the complex Hilbert space model, the continuum that embeds the enumerators of the Hilbert base vectors is formed by the system of the complex numbers. This continuum belongs as eigenspace to the enumerator operator that resides in the Gelfand triple. It is sensible to let the real part of the Hilbert base enumerators represent progression. The same will happen to the real axis of the embedding continuum. On the real axis of the embedding continuum the interspacing can be kept fixed. Instead, it is possible to let the distance function control the interspacing in the imaginary axis of the embedding continuum. The values of the rational complex enumerators are used as parameters for the distance function. The complex value of the distance function determines the target location for the corresponding enumerator in the continuum. The distance function establishes the necessary coherence between the subsequent Hilbert spaces in the sequence. The difference with the real Hilbert space model is, that now the progression is included into the values of the enumerators. The result of these choices is that the whole model steps with (very small, say practically infinitesimal) fixed progression steps.

In the model that uses complex Hilbert spaces, the enumeration operator has rational complex numbers as its eigenvalues. In this Hilbert space model, the fixed enumeration real step size and the fixed enumeration imaginary step size define ***a maximum speed***. Again the eigenvectors of this (complex) operator are the target of the enumerator whose value corresponds to the complex eigenvalue.

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[10] This story also applies to the complex and the quaternionic Hilbert spaces and their Gelfand triples.

If we ignore the case of negative progression, then the complex Hilbert model exist in two forms, one in which the interspacing appears to expand and one in which the interspacing decreases with progression[11].

2.5.4 Quaternionic Hilbert space model

When a quaternionic separable Hilbert space is used to model the static quantum logic, then it is sensible to use rational quaternions for the enumeration. Again the fixed enumeration step sizes are preserved for the real part of the enumerators and again the real parts of the enumerators represent progression. The continuum that embeds the enumerators is formed by the number system of the quaternions. The scaling distance function of the complex Hilbert space translates into an isotropic scaling function in the quaternionic Hilbert space. However, we may instead use a full 3D distance function that incorporates the isotropic scaling function. This new distance function may act differently in different spatial dimensions. However, when this happens at very large scales, then it conflicts with the cosmological principle. At those scales the distance function must be isotropic.

Now the enumeration operator of the Hilbert space has rational quaternions as its eigenvalues. The relation between eigenvalues, eigenvectors and enumerators is the same as in the case of the complex Hilbert space. Again the whole model steps with fixed progression steps.

2.5.4.1 Curvature and fundamental fuzziness

The fixed interspacing that is used with complex Hilbert spaces poses problems with quaternionic Hilbert spaces. Any regular interspacing pattern will introduce preferred directions. Preserved directions are not observed in nature[12] and the model must not create them. A solution is formed by the ***randomization of the interspacing***. Thus instead of a fixed interspacing we get an average interspacing. This problem does not play on the real axis. On the real axis we can still use a fixed interspacing. The result is an ***average maximum speed***. Further, the actual location of the enumerators in the embedding continuum will be determined by the combination of a sharp distance function and a quaternionic probability amplitude distribution (QPAD) that specifies the local blur. The form factor of the blur may differ in each direction and is set by the differential of the sharp distance function. The total effect is given by the convolution of the sharp distance function and the adapted QPAD.

The requirement that the cosmological principle must be obeyed is the cause of a fundamental fuzziness of the quaternionic Hilbert model. It is the reason of existence of quantum physics.

At larger distances the freedom that is tolerated by the distance function causes ***curvature of observed space***. However, as explained before, at very large scales the distance function must be isotropic. The local curvature is described by the differential of the distance function.

This picture only tells that space curvature might exist. It does not describe the origin of space curvature. That origin is treated in the Hilbert Book Model.

[11] The situation that expands from the point of view of the countable enumeration set, will contract from the point of view of the embedding continuum of enumerators.

[12] Preserved directions are in conflict with the cosmological principle.

2.5.4.2 Discrete symmetry sets

Quaternionic number systems exist in 16 forms (sign flavors) that differ in their discrete symmetry sets. Four members of the set represent isotropic expansion or isotropic contraction of the imaginary interspacing. At large scales two of them are symmetric functions of progression. The other two are at large scales anti-symmetric functions of progression. We will take the symmetrical member that expands with positive progression as the ***reference quaternionic number system***. Each member of the set corresponds with a quaternionic Hilbert space model. Even at the instance of the reference Hilbert space, the distance function must be a continuous function of progression.

A similar split occurs with continuous quaternionic functions. For each discrete symmetry set of their parameter space, the function values of the continuous quaternionic distribution exist in 16 versions that differ in their discrete symmetry set. Within the target domain of the quaternionic distribution the symmetry set will stay constant.

2.5.4.3 Generations and Qpatterns

Several generations of QPAD's exist. This model does not explain the existence of generations. For a selected generation the following holds:

Apart from the adaptation of the form factor that is determined by the local curvature and apart from the discrete symmetry set of the QPAD, the QPAD's are everywhere in the model the same.

Therefore we will call this basic form of the selected QPAD generation a ***Qpattern.*** For each generation, *Qpatterns exist in 16 versions that differ in their* discrete symmetry set.

2.6 The reference Hilbert space

At large and medium scales the first member of the sequence of quaternionic Hilbert spaces is supposed to have a uniform distribution of the enumerators in the embedding continuum. This is realized by requiring that the eigenspace of the enumeration operator that acts in the Gelfand triple of the zero progression value Hilbert space represents the reference embedding continuum. With other words, at this instance of progression, the rational quaternionic enumeration space is ***flat***. This member of the sequence still features a stochastic interspacing in the imaginary part of the embedding quaternionic continuum. For the reference Hilbert space the isotropic scaling function is symmetric at zero progression value. Thus for the reference Hilbert space at the reference progression instance the distribution of the enumerators will realize a ***densest packaging***[13].

For all subsequent Hilbert spaces the embedding continuum will be taken from the Gelfand triple of the first reference Hilbert space.

[13] The densest packaging will also be realized locally when the geometry generates black holes.

3 The enumeration process

It is not yet clear how Qpatterns will be shaped. This information can be derived from the requirements that are set for the correlation vehicle. We will start with an assumption for the enumeration process that for this vehicle will lead to the wanted functionality.

Hypothesis: At small scales the enumeration process is governed by a Poisson process.

The lateral spread that goes together with the low scale randomization of the interspacing plays the role of a binomial process. The combination of a Poisson process and a binomial process is again a Poisson process, but locally it has a a lower efficiency than the original Poisson process. For a large number of enumerator generations the resulting Poisson distribution resembles a Gaussian distribution. If the generated enumerators are considered as charge carriers, then the corresponding potential has the shape of an Error function. Already at a short distance from its center location the Error function starts decreasing with distance r as a $1/r$ function.

Now we remember Bertrand's theorem.[14] :

Bertrand's theorem states that only two types of central force potentials produce stable, closed orbits:

(1) an inverse-square central force such as the gravitational or electrostatic potential

$$V(r) = \frac{-k}{r}$$

and

(2) the radial harmonic oscillator potential

$$V(r) = ½\, k\, r^2$$

With other words the assumption that the enumerators are generated by a Poisson process produces the proper cohesion requirements for the correlation vehicle.

According to this investigation the undisturbed shape of the Qpatterns can be characterized as Gaussian distributions.

4 Geometric model

The geometric model applies the quaternionic Hilbert space model. From now on the complex Hilbert space model and the real Hilbert space model are considered to be abstractions of the quaternionic model. It means that the special features of the quaternionic model bubble down to the complex and real models. For example both lower dimensional enumeration spaces will show blur at small

[14] http://en.wikipedia.org/wiki/Bertrand's_theorem.

enumeration scales and both models will show a simulation of the discrete symmetry sets that quaternionic systems and functions possess. This can be achieved with spinors and Dirac matrices.

At large scales the model can properly be described by the complex Hilbert space model. At those scales the quaternionic model is isotropic.

We will place the reference Hilbert space at zero progression value.

Quaternionic numbers exist in 16 discrete symmetry sets. When used as enumerators, half of this set corresponds with negative progression and will not be used in this geometric model.

As a consequence we will call the Hilbert space at zero progression value the start of the model.

4.1 RQE's

RQE stands for rational quaternionic enumerator. This lowest geometrical level is formed by the enumerators of a selected Hilbert space base. In this level, the embedding continuum is not included. The Hilbert space is a selected member of the sequence of Hilbert spaces. The sequence number corresponds with the progression value in the real part of the value of the RQE. In principle the enumerators enumerate an unordered set.

The ordering and the corresponding origin of space become relevant when an observer object considers one or more observed objects. The real part of the enumerators defines progression. In physics progression conforms to proper time. As a consequence according to our model, the equivalent of proper time steps with a fixed step.

HYPOTHESIS: At its start nature used only one discrete symmetry set for its lowest level of geometrical objects. This discrete symmetry set is the same set that characterizes the reference continuum. This situation stays throughout the history of the model. This set corresponds with the reference quaternionic Hilbert space model.

Due to this restriction the RQE-space is not afflicted with splits and ramifications[15].

4.2 Palestra

The second geometric level is a curved space, called Palestra. It consists of an embedding continuum and the embedded RQE set. The local curvature is defined via the differential of the continuous (sharp) quaternionic distance function. The parameter space of the distance function is formed by the RQE-set. Thus since the RQE-set is countable, the Palestra contains a countable set of images of the sharp distance function. We will call these images "Qpatches". The distance function may include an isotropic scaling function. The differential of the distance function defines an infinitesimal quaternionic step. In physical terms the length of this step is the infinitesimal coordinate time interval. The differential is a linear combination of sixteen partial derivatives. It defines a quaternionic metric. Like the first geometric

[15] http://en.wikipedia.org/wiki/Quaternion_algebra#Quaternion_algebras_over_the_rational_numbers

level, this level represents an affine space. The enumeration process adds an arbitrary origin. Like all continuous quaternionic functions, for each discrete symmetry set of its parameter space, the distance function exists in 16 different discrete symmetry sets for its function values. This means that also 16 different embedding continuums exist. As a consequence, there are 16 different versions of the Palestra. However, these versions may superpose. The symmetry set of the distance function values may differ from the symmetry set of the parameter space of the distance function. The distance function keeps its discrete symmetry set throughout its life. One of the 16 Palestras acts as reference Palestra. The corresponding distance function and thus this reference Palestra has the same discrete symmetry set as the lowest level of the geometrical objects.

4.3 Qpatches

The third level of geometrical objects consists of a countable set of space patches that occupy the Palestra. We already called them Qpatches. They are images of the RQE's that house in the first geometric object level. The set of RQE's is used as parameter space for the distance function. Apart from the rational quaternionic value of the corresponding RQE, their charge is formed by the discrete symmetry set of the distance function. The curvature of the second level space relates directly to the density distribution of the Qpatches. The Qpatches represent the locations of the regions where next level objects can be detected. The name Qpatch stands for space patches with a quaternionic value. The charge of the Qpatches can be named Qsymm, Qsymm stands for discrete symmetry set of a quaternion. However, we already established that the value of the enumerator is also contained in the property set that forms the Qsymm charge.

The enumeration problems that come with the quaternionic Hilbert space model indicate that the Qpatches are in fact centers of a fuzzy environment that houses the potential locations where the actual RQE image can be found. ***A Qpatch is a non-blurred image of a RQE***.

4.4 QPAD's

The fuzziness in the correlated sampling of the enumerators and their images in the reference continuum is described by a ***quaternionic probability amplitude distribution*** (QPAD). The squared modulus of the QPAD represents the probability that an image of a Qpatch will be detected on the location that is specified by the value of the parameter of the blurred distance function. The ***QPAD's that act as Qpatterns have a flat parameter space in the form of a quaternionic continuum.*** The QPAD adds blur to the sharp distance function. The blurred distance function is formed by the ***convolution*** of the sharp distance function with the a QPAD that equals an adapted Qpattern. The adaptation concerns the form factor. The form factor may differ in each direction. It is determined by the differential of the sharp distance function. On detection the image produced by a the blurred distance function is a ***Qtarget***.

Qtargets only exist when a corresponding detection is performed.

QPAD's are quaternionic distributions that contain a scalar potential in their real part that describes a density distribution of ***potential*** Qtargets. Further they contain a 3D vector potential in their imaginary part that describes the associated current density distribution of potential Qtargets. Continuous quaternionic distributions exist in eight different discrete spatial symmetry sets. However, the QPAD's inherit the discrete symmetry of their connected distance function.

4.5 Blurred distance functions

The blurred distance function has a flat parameter space that is formed by rational quaternions. Fourier transforms cannot be defined properly for functions with a curved parameter space, however, the blurred distance functions have a well-defined Fourier transform. The Fourier transform pairs and the corresponding canonical conjugated spaces form a double-hierarchy model.

The Fourier transform of the blurred distance function equals the product of the Fourier transform of the sharp distance function and the Fourier transform of the Qpattern.

16 blurred distance function exist that together cover all Qpatches. One of the 16 blurred distance functions acts as reference. The corresponding sharp distance function and thus the corresponding QPAD have the same discrete symmetry set as the lowest level space.

4.6 Local and integral QPAD's

The model uses Qpatterns in order to implement the fuzziness of the local interspacing. After adaptation of the form factor to the differential of the sharp distance function a local QPAD is generated. The superposition of all these local QPAD's forms an integral QPAD. Each of the 16 blurred distance functions corresponds to an integral QPAD.

In principle the Qpatterns may extend over the whole Palestra. However, the amplitude of these local QPAD's diminishes with the distance from their center point.

4.7 Generations

Photons and gluons correspond to Qpatterns that have no lateral extension.. Two photon Qpatterns and six gluon Qpatterns exist[16].

Further, (at least) three generations of Qpatterns exist that have non-zero extension and that differ in their basic form factor.

4.8 Elementary particles

Elementary particles are constituted by the coupling of two Qpatterns that belong to the same generation. One of the Qpatterns is the quantum state function of the particle. The other Qpattern implements inertia. Apart from their sign flavors these constituting Qpatterns form the same quaternionic distribution. However, the sign flavor must differ and their progression must have the same direction. This results in 56 elementary particle types, 56 anti-particle types and 8 non-particle types. The coupling has a small set of observable properties: coupling strength, electric charge, color charge and spin. The coupling affects the local curvature of the involved Palestras.

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[16] Bertrand's theorem indicates that the Qpatterns of photons and gluons might be described as radial harmonic oscillators.

Qpatterns that belong to the same generation have the same shape. The difference between the coupling partners resides in the discrete symmetry sets. ***Thus the properties of the coupled pair are completely determined by the sign flavors of the partners.***

HYPOTHESIS: If the quaternionic quantum state function of an elementary particle couples to a local piece of the reference integral two-stage QPAD, then the particle is a fermion, otherwise it is a boson. For anti-particles the quaternionic conjugate of the reference integral two-stage QPAD must be used. Non-coupled Qpatterns are bosons.

The coupling of two Qpatterns is controlled by a coupling equation

$$\nabla\psi = m\,\phi$$

This equation is equivalent to a quaternionic differential continuity equation.

$$\nabla\psi = \varphi$$

And it is equivalent to a quaternionic differential equation.

$$\varphi = \nabla\psi$$

Here ∇ is the quaternionic nabla. ψ, ϕ and φ are Qpatterns that belong to the same generation.

Photons and gluons belong to a generation that does not couple.

In the standard model the eight gluons are constructed from superpositions of these six base gluons.

4.8.1 Coupling Qpatterns

Qpatterns are not static. Instead they oscillate. The interpretation of this oscillation is that on the average the Qpattern keeps its location and it keeps its size. Thus an outbound move must be followed by an inbound move. The zero order temporal frequency of this oscillation is set by the progression step. In this light coupling means the synchronization of the involved Qpatterns. The sharp distance function takes care of the slower part of the dynamics. The synchronization can involve oscillations that are in-phase and oscillations that are in anti-phase. These criterions may act isotropic or they may hold in one or two dimensions.

The coupling uses pairs $\{\psi^x, \psi^y\}$ of two sign flavors. Thus the coupling equation runs:

$$\nabla\psi^x = m\,\psi^y$$

Corresponding anti-particles obey

$$(\nabla\psi^x)^* = m\,(\psi^y)^*$$

The anti-phase couplings must use different sign flavors. In the figure below $\psi^{⓪}$ acts as the reference sign flavor.

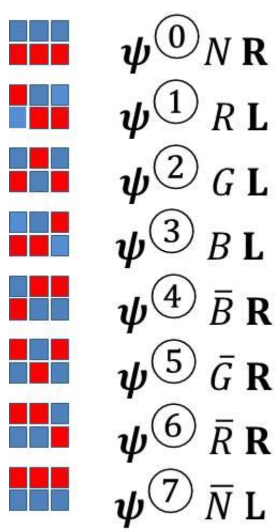

Figure 1: Sign flavors

Eight sign flavors

(discrete symmetries)

Colors N, R, G, B, $\overline{\mathrm{R}}$, $\overline{\mathrm{G}}$, $\overline{\mathrm{B}}$, W

Right or Left handedness **R,L**

4.8.2 Elementary particle properties

4.8.2.1 Spin

Spin relates to the fact whether the coupled Qpattern is the reference Qpattern. Each generation has its own reference Qpattern.

4.8.2.2 Electric charge

Electric charge depends on the difference and direction of the base vectors for the Qpattern pair. Each sign difference stands for one third of a full electric charge. Further it depends on the fact whether the handedness changes. If the handedness changes then the sign of the count is changed as well.

4.8.2.3 Color charge

The color charge of the reference Qpattern is white. The corresponding anti-color is black. The color charge of the coupled pair is determined by the color of its members.

4.8.2.4 Mass

Mass is related to the number of involved Qpatches.

4.8.3 Samples

With these ingredients we can look for agreements with the standard model.

4.8.3.1 Leptons

According to the Standard Model the leptons comprise three generations

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{\textcircled{7}},\psi^{\textcircled{0}}\}$	fermion	-1	N	**LR**	electron
$\{\psi^{\textcircled{0}},\psi^{\textcircled{7}}\}$	Anti-fermion	+1	W	**RL**	positron
$\{\psi^{\textcircled{1}},\psi^{\textcircled{0}}\}$	fermion	-1/3	R	**LR**	down-quark
$\{\psi^{\textcircled{6}},\psi^{\textcircled{7}}\}$	Anti-fermion	+1/3	$\overline{\mathrm{R}}$	**RL**	Anti-down-quark
$\{\psi^{\textcircled{2}},\psi^{\textcircled{0}}\}$	fermion	-1/3	G	**LR**	down-quark
$\{\psi^{\textcircled{5}},\psi^{\textcircled{7}}\}$	Anti-fermion	+1/3	$\overline{\mathrm{G}}$	**RL**	Anti-down-quark
$\{\psi^{\textcircled{3}},\psi^{\textcircled{0}}\}$	fermion	-1/3	B	**LR**	down-quark
$\{\psi^{\textcircled{4}},\psi^{\textcircled{7}}\}$	Anti-fermion	+1/3	$\overline{\mathrm{B}}$	**RL**	Anti-down-quark
$\{\psi^{\textcircled{4}},\psi^{\textcircled{0}}\}$	fermion	+2/3	$\overline{\mathrm{B}}$	**RR**	up-quark
$\{\psi^{\textcircled{3}},\psi^{\textcircled{7}}\}$	Anti-fermion	-2/3	B	**LL**	Anti-up-quark
$\{\psi^{\textcircled{5}},\psi^{\textcircled{0}}\}$	fermion	+2/3	$\overline{\mathrm{G}}$	**RR**	up-quark
$\{\psi^{\textcircled{2}},\psi^{\textcircled{7}}\}$	Anti-fermion	-2/3	G	**LL**	Anti-up-quark
$\{\psi^{\textcircled{6}},\psi^{\textcircled{0}}\}$	fermion	+2/3	$\overline{\mathrm{R}}$	**RR**	up-quark
$\{\psi^{\textcircled{1}},\psi^{\textcircled{7}}\}$	Anti-fermion	-2/3	R	**LL**	Anti-up-quark

The generations contain the muon and tau generations of the electrons, the charm and top versions of the up-quark and the strange and bottom versions of the down-quark.

4.8.3.2 W-particles

W-particles have indiscernible color mix. $W_+$and W_- are each other's anti-particle.

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{⑥},\psi^{①}\}$	boson	-1	$\mathrm{R}\overline{\mathrm{R}}$	**RL**	W_-
$\{\psi^{①},\psi^{⑥}\}$	Anti-boson	+1	$\overline{\mathrm{R}}\mathrm{R}$	**LR**	W_+
$\{\psi^{⑤},\psi^{②}\}$	boson	-1	$\mathrm{G}\overline{\mathrm{G}}$	**RL**	W_-
$\{\psi^{②},\psi^{⑤}\}$	Anti-boson	+1	$\overline{\mathrm{G}}\mathrm{G}$	**LR**	W_+
$\{\psi^{⑤},\psi^{②}\}$	boson	-1	$\mathrm{G}\overline{\mathrm{G}}$	**RL**	W_-
$\{\psi^{②},\psi^{⑤}\}$	Anti-boson	+1	$\overline{\mathrm{G}}\mathrm{G}$	**LR**	W_+
$\{\psi^{④},\psi^{③}\}$	boson	-1	$\mathrm{G}\overline{\mathrm{G}}$	**RL**	W_-
$\{\psi^{③},\psi^{④}\}$	Anti-boson	+1	$\overline{\mathrm{G}}\mathrm{G}$	**LR**	W_+

4.8.3.3 Z-candidates

Z-particles have indiscernible color mix.

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{③},\psi^{①}\}$	boson	0	BR	**LL**	Z
$\{\psi^{①},\psi^{③}\}$	boson	0	RB	**LL**	Z
$\{\psi^{④},\psi^{⑥}\}$	boson	0	$\overline{\mathrm{R}}\overline{\mathrm{B}}$	**RR**	Z
$\{\psi^{⑥},\psi^{④}\}$	boson	0	$\overline{\mathrm{R}}\overline{\mathrm{B}}$	**RR**	Z

4.8.3.4 Neutrinos

Neutrinos are fermions and have zero electric charge. They belong to a separate low-weight set of generations. They couple to a Qpattern that has the same sign-flavor. They have mass.

4.8.3.5 Other particles

When we include photons, gluons and neutrinos, then we can identify 35 particle types that conform to corresponding SM particles. A multitude of pairs do not conform to an SM-particle. They are all bosons. Some are neutral and others have electric charge. They all have rest mass.

4.9 Physical fields

Elementary particles conserve their properties in higher level bindings. These properties are sources to new fields. Besides the photons and the gluons these fields are the physical fields that we know. These new fields can be described by quaternionic distributions and when they cover large numbers of particles they can be described with quaternionic distributions that contain density distributions like the QPAD's described above. However, their charge carriers are particles and not Qpatches and their charge is a property of the corresponding particle. One of the physical fields, the gravitation field describes the local curvature of the reference Palestra.

5 Conclusion

With respect to conventional physics, this simple model contains extra layers of individual objects. The most interesting addition is formed by the RQE's and the Qpatches.

The model gives an acceptable explanation for the existence of an (average) maximum velocity of information transfer. The three prepositions:

- Atomic quantum logic fundament
- Correlation vehicle
- Cosmologic principle

Lead to the existence of fuzzy interspacing of enumerators of the Hilbert space base vectors and to dynamically varying space curvature when compared to a flat reference continuum.

Without the freedom that is introduced by the interspacing fuzziness and which is used by the dynamic curvature, no dynamic behavior would be observable in the Palestra.

In the generation of the model the enumeration process plays a crucial role, but we must keep in mind that the choice of the enumerators and therefore the choice of the type of correlation vehicle is to a large degree arbitrary. It means that the Palestra has no natural origin. It is an affine space.

Physicist that base their model of physics on an equivalent of the Gelfand triple which lacks a mechanism that creates the freedom that flexible interspaces provide, are using a model in which no natural curvature and fuzziness can occur. Such a model cannot feature dynamics.

Attaching a progression parameter to that model can only create the illusion of dynamics. However, that model cannot give a proper explanation of the existence of space curvature, space expansion, quantum physics or even the existence of a maximum speed of information transfer.

Please attack these statements with your criticism.