Sketch of the design of the Hilbert Book Model

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Preface

Two ways exist in which the Hilbert Book Model can be introduced. The first way starts with the space-progression model aspects and introduces the HBM as a paginated model. This approach is described in “The stochastic nature of quantum physics”, http://vixra.org/abs/1312.0043.The second way starts with the foundation that describes the fundamental relational structure of the HBM. This approach is described here.

Introduction

The Hilbert Book Model is a simple, largely deduced model of the lower levels of quantum physics that is strictly based on quantum logic.

A sturdy and well accepted foundation like quantum logic is selected because the rest of the model is fully deduced and cannot be extensively supported by experimental verification. By using this basis and further relying on trustworthy deduction the researcher can penetrate deeper in the lower layers of the foundations of physics than when only observable facts may be assumed and yet avoid that fantasy strikes rampantly.

One of the most remarkable achievements of early quantum physics was the result obtained by the duo John von Neumann and Garret Birkhoff who discovered that the set of propositions in a quantum logical system is lattice isomorphic to the set of closed subspaces of an infinite dimensional separable Hilbert space. With other words, in this way two nearly equivalent models are available that can act as foundation for quantum physics. The HBM uses both models.

Classical logic would have been a suitable foundation of physics, but since the discovery of Birkhoff and von Neumann we know that nature cheats with classical logic and instead obeys quantum logic. Quantum logic differs in one of its ~25 axioms from classical logic. Quantum logic has a weaker version of the modular law. As a consequence also the distributive law no longer holds. Due to this small difference in the axioms the structure of quantum logic is far more complicated than the structure of classical logic.

Quantum logic is accepted as nature's logic by most researchers of the foundations of quantum physics. See: http://en.wikipedia.org/wiki/Quantum_logic

The Hilbert Book Model project shows that quantum logic and its lattice related companion, the Hilbert space, can both be used as foundation of physics. The selected base can be extended. First the problem must be solved that both quantum logic and the Hilbert space can only represent a static status quo. This extension leads to a paginated space-progression model.

By extending the selected base, it is possible to generate step by step a full blown model of the lowest levels of physics that ranges from space and progression, via fields and elementary particles up to simple composites.

Many of the features that play a role in the deduced model cannot be observed. However, in the resulting model potentials, photons, and elementary particles play their "normal" role.

Why quantum logic can be used as foundation

In no way a model can give a precise description of physical reality. At the utmost it presents a correct view on physical reality. But, such a view is always an abstraction.

Physical reality is very complicated. It seems to belie Occam's razor. However, views on reality that apply sufficient abstraction can be rather simple and it is astonishing that such simple abstractions exist. Complexity is caused by the number and the diversity of the relations that exist between objects that play a role. A simple model has a small diversity of its relations.

Mathematical structures might fit onto observed physical reality because its relational structure is isomorphic to the relational structure of these observations.

The part of mathematics that treats relational structures is lattice theory[1]. Logic systems are particular versions of lattice theory. Classical logic has a simple relational structure[2]. However since 1936 we know that physical reality cheats classical logic. Since then we think that nature obeys quantum logic, which has a much more complicated relational structure. Mathematics offers structures that are lattice isomorphic to quantum logic. One of them is the set of closed subspaces of a separable Hilbert space.

The conclusion of this deliberation is that physical reality is not based on mathematics, but that it happens to feature relational structures that are similar to the relational structure that some mathematical constructs have. That is why mathematics fits so well in the formulation of physical laws. Physical laws formulate repetitive relational structure and behavior of observed aspects of nature.

Extension of the foundation

A fist possibility to extend the primitive model is the addition of the Gelfand triple to the separable Hilbert space. The separable Hilbert space can only model countable sets. This extension adds the ability to model continuums.

Neither quantum logic, nor its lattice isomorphic companion, the set of subspaces of the separable Hilbert space, has natural means to implement dynamics. Thus, the first extension step is to construct a dynamic model by taking an ordered sequence of these static sub-models as a base for the dynamic model.

This model resembles a book in which every page describes a static status quo of the universe. The page number acts as a progression parameter. The progression step size can be taken to be rather constant and in that case it corresponds to a super-high frequency which represents the tick of the progression clock. The direct consequences of the nearly constant progression step size are that progression appears to be fundamentally quantized and that the universe can be considered to be completely regenerated at every progression step.

With other words, the HBM is a paginated model. In contrast to the spacetime model that is used by contemporary physics and which has a Minkowski signature, this space-progression model has an Euclidean signature and can be comprehended much easier. The paginated model can be easily represented by quaternions, which in this case prove that they are nature's preferred number

[1]The German name for lattice theory is Theorie der Verbände.
[2] It can be represented by Venn diagrams.

system. The corresponding regeneration of the universe puts a different light on how nature operates at its lowest levels. In the spacetime model this view is impracticable.

The second extension step is the refinement of quantum logic by restricting the propositions to propositions that can be characterized by a numeric value, which can play the role of a relevance characteristic and can also act as a coefficient in linear combinations. This results in a Hilbert logic system that has a greater correspondence to the Hilbert space than quantum logic has. For this logic, propositions correspond to Hilbert vectors, while for quantum logic, propositions correspond to Hilbert subspaces.

Hierarchy

Now we have created a threefold hierarchy. Hilbert vectors span Hilbert subspaces and Hilbert logic propositions span quantum logic propositions. These hierarchies correspond to constituents that configure building blocks.

If the building blocks are interpreted as elementary particles, then these particles have constituents! Elementary particles are often interpreted as point-like objects. So, what are these constituents?

If the Hilbert vectors that span the building block subspace are eigenvectors, then the eigenvalues enumerate the constituents of the building block. Now the question shifts to what the enumerators are. If the corresponding operator is an allocation operator in the Hilbert space, then these enumerators are positions of the building block. In that case the building block can still be a point-like object.

Building blocks

The building block cannot be at multiple positions at the same instance. However, it can walk along these locations. Thus at every progression step the building block arrives at a new eigenvalue of the allocation operator. The reserved locations are not ordered. Thus the walk goes along a stochastic micro-path. This path is formed in an embedding continuum that represents the “living space” for the building blocks.

The building block can be interpreted as a point-like object that is represented by a coherent set of reserved locations. These reserved locations are the (mostly virtual) constituents of the building block.

The reserved locations can be described by a continuous density distribution. If the locations are distributed as a 3D normal distribution (or something like such a distribution), then the density distribution can be interpreted as a probability density distribution. In that case it conforms in its functionality to the squared modulus of the quantum state function (wave function) of the particle. Thus some extra mechanism must exist that takes care that the distribution of reserved locations can be interpreted as a probability density distribution. That mechanism does not house in the logic systems and it does not house in the Hilbert space. It is an "external" mechanism!

Continuity

The above sketch is only a part of the full story. For example the choice for modeling a dynamic system by an ordered sequence of static sub-models asks for measures that keep sufficient coherence between the members of the sequence, otherwise only dynamic chaos will result. On the other hand the coherence must not be too stiff otherwise no actual dynamics will take place. The stochastic blur of the location of the building blocks can take care of this last point. The fact that the form of this blur is such that it acts as a probability density function serves the first point. These extra restrictions are far from obvious! They form part of the reason why the model is a quantum physical model.

Living space

The mechanism that installs the coherence of the blur uses the fact that the locations are embedded in a continuum. It is a known fact that this continuum is curved. Thus the best choice is to implement this continuum in the model as a field. The continuum must somehow be coupled to the separable Hilbert space. That Hilbert space has no natural means to support a continuum. Its operators have countable eigenspaces. However, each separable Hilbert space possesses a Gelfand triple, which provides operators that have a continuum as their eigenspace. Thus, the background field that will act as the representation of the curved space that we experience as our living room can be taken from the Gelfand triple. This also means that the external mechanism not only must recreate the eigenspaces of allocation operators in the Hilbert space, but it must also recreate the eigenspaces of operators in the Gelfand triple. In this way the eigenspaces of these operators can act as storage places.

Potentials

It is well known that massive particles curve the continuum in which they are embedded. This curvature is described by the gravitation potential of the particle. Besides of this gravitation potential, particles can also feature an electrostatic potential.

Since particles move and can be generated and annihilated, the generation of these potentials is a dynamic affair. Since the whole universe appears to be regenerated at every progression step this also holds for the background field and for the potentials.

So we must find an explanation how this occurs.

Why particles have potentials

The question why particles possess fields can better be answered by turning the question into the problem why embedding fields accept particles. Embedding fields can be represented by analytic[3] quaternionic functions and such functions adapt singularities. Elementary particles represent singularities in a field that is represented by an analytic quaternionic function. The singularities are the result of the ongoing embedding of particles into the field that acts as the embedding continuum. In a paginated model these singularities can be interpreted as sources or drains. This view transfers physics into a kind of fluid dynamics.

Step stones and super-high frequency waves

As shown above nature's building blocks can be represented by a coherent set of step stones. The step stones form a stochastic micro-path and even at rest the building block walks along this micro-path.

At every arrival at a step stone the building block emits information about its presence and its properties. This information is transported via a wave front that slightly folds and thus curves the embedding continuum. This is the mechanism that transports the information and at the same time

[3] Here we consider a quaternionic function analytic when except for a finite discrete set of singular points the quaternionic nabla for this function exists.

it is the mechanism that curves the background field. The phenomenon is the origin of space curvature and can be described by the gravitation potential of the particle.

The wave fronts are generated at slightly different locations. At small scales they interfere. Already at a small distance the wave fronts seem to come from a rather stationary location that serves as the location of the building block. Together the wave fronts form super-high frequency waves. This frequency is so high that the waves themselves cannot be observed. However, their influences are noticeable in the form of potentials and these waves act as carrier waves for photons, which appear as modulations of these carrier waves when the emitter suddenly decreases its energy.

Regenerating universe

Further the wave fronts that are emitted by all massive particles in universe superpose (interfere) to form the shape of the background field that acts as (curved) embedding continuum.

The Hilbert Book Model gets its name from the fact that in this model universe proceeds with universe wide steps from one static status quo to the next. In universe a single universe wide (proper) time clock ticks. It corresponds with a super-high frequency.

At each progression step the whole universe is recreated. The propagation of waves is governed by something that is similar to Huygens principle. This mechanism renews the wave fronts of the super-high frequency waves at every progression step. As a consequence also the background field that is deformed by all wave fronts that were emitted by massive particles and that acts as our curved space will be regenerated at every progression step.

Each page of the book describes only the spatial picture. Dynamics is implemented by the ordered sequence of these pictures. Inside a page no interaction takes place. Interaction occurs only between pages and subsequent pages. The direction of these interactions is from lower page numbers to higher page numbers.

Correlation vehicle

An external mechanism guards sufficient coherence between subsequent pages. Without this mechanism space and progression are completely decoupled.

The mechanism controls both the regeneration of the elementary particles and the regeneration of the wave fronts. In this way also the potentials and the background field that acts as an embedding continuum are regenerated.

An extra restriction that is installed by the correlation mechanism is that the coherent discrete distribution of step stones can be characterized by a continuous step stone density distribution that exists in the embedding continuum. Further the mechanism ensures that this continuous object density distribution can be characterized as a probability density distribution. If this is the case, then the object density distribution can be considered as the squared modulus of the wave function of the considered object. This describes the fundamental stochastic nature of the universe wide time clock model. These extra restrictions are far from obvious. The consequence is that the stochastic micro-path is generated in a recurrent fashion such that important statistical attributes are reinstalled in a cyclic fashion.

If after walking along the full micro-path the next walk keeps the average location of the step stones at the same location, then the object is considered to stay at rest or to take part in an oscillatory movement such that the micro-path is stretched along the path of the oscillation. If that is not the case, then the object is considered to move and the micro-path is considered to be stretched along the path of that movement.

Here the correlation mechanism will put another restriction that concerns the stretching of the micro-path along the movement or oscillation paths. This must occur such that that the Fourier transform of the density distribution of the step stones will reflect the probability distribution of the momenta that characterize the motion. This restriction reflects the impact of Heisenberg's uncertainty principle. Again, this extra requirement is far from obvious.

Together these restrictions render the model as a quantum physical system and support the particle-wave nature of the objects that are controlled by the correlation mechanism. It means that the step stones can create interference patterns.

Implementation of the correlation mechanism

The particle regenerator can be implemented by a blurred allocation function $\mathcal{P}$. That function is a convolution of a sharp continuous allocation function $\wp$ and a stochastic spatial spread function $\mathcal{S}$. The stochastic spatial spread function is implemented by the combination of a Poisson process and an attenuating binomial process. The binomial process is implemented by a 3D spread function.

$$\mathcal{P} = \wp \circ \mathcal{S} \tag{1}$$

$\mathcal{P}$ has a flat parameter space that is spanned by a quaternionic number system. At selected parameter locations, the stochastic spatial spread function $\mathcal{S}$ generates a planned step stone distribution that can be described by a continuous quaternionic object density distribution ψ.

Since the stochastic spatial spread function houses the generator of space curvature and the sharp continuous allocation function describes local curvature, these two parts must be in concordance with each other.

The propagation and regeneration of the wave fronts is controlled by something that is similar to the Huygens principle. This mechanism has to cope with the regular regeneration of the whole universe. Indirectly this mechanism controls the potentials and the form of the background field. Also this part of the correlation vehicle must be in concordance with the other parts.

$\wp$ changes per progression step, but $\mathcal{S}$ changes per job production cycle. That cycle lasts until the complete micro-path has been walked by the selected particle.

The differential $d\wp$ of the sharp continuous allocation function defines a local metric ds, which describes the local curvature of the background field .

$$ds(x) = ds^{\nu}(x) e_{\nu} = d\wp = \sum_{\mu=0\ldots3} \frac{\partial \wp}{\partial x_{\mu}} dx_{\mu} = q^{\mu}(x) dx_{\mu} \tag{2}$$

$$= \sum_{\mu=0\ldots3} \sum_{\nu=0,\ldots3} e_\nu \frac{\partial \wp_\nu}{\partial x_\mu} dx_\mu = \sum_{\mu=0\ldots3} \sum_{\nu=0,\ldots3} e_\nu q_\nu^\mu dx_\mu$$

This quaternionic metric is a linear combination of 16 partial derivatives q_ν^μ. This leads to a quaternionic curvature theory.

Jobs

Some tasks are completed before the correlation vehicle stops with the current job. For example a micro-walk is completed before the generator stops generating new step stones. Some related jobs behave similarly. For example the emission or absorption of photons also finish their task after completion of the job. The efficiency of the Poisson process determines the number of step stones in the micro-path.

Some aspects of the model

The behavior of the deepest layers of physics can fairly clear be told in a pictorial way. The Hilbert Book Model gives a unique picture of these lower layers.

In the HBM nature's building blocks (elementary particles) are represented by coherent collections of what I call stepping stones. The stepping stones are temporary reserved locations where the building block can be found. The set of reserved locations are generated at random and are not ordered. This looks as if they are generated by a stochastic process. In fact the planned distribution looks like a 3D normal distribution.

At each progression instant only one step stone is used. It is never known beforehand which step stone is the next one. In this way the building block, even at rest, walks along a stochastic micro-path. At each arrival at a new step stone the building block emits a wave front that carries information about the presence and properties of the building block. This wave front moves with the greatest possible speed away from its source.

The wave fronts slightly fold and thus curve the continuum that embeds the particle. This is the way that the carried information is propagated. It is also the way that space curvature is created.

In the described way, the wave fronts are transmitted from slightly different locations. Already at a short distance the wave fronts seem to be generated at an super-high frequency by a source that has a fairly stationary location. In this way the particle does not represent a singularity for the gravitation potential. Instead of the 1/r dependence, the dependence looks more like Erf(r)/r. Already at a short distance r this function resembles closely the singular 1/r. Thus the spread dampens the self-interaction of the particle. In this way the particle is hardly touched by its own gravitation field.

Thus, the singularities form a wide pitch or a ditch, but then one dimension higher than the usual interpretation of these phenomena. The ditch may form a geodesic.

Together, the wave fronts that are emitted by the particle form a super-high frequency wave. The frequency of this wave is so high that in no way the wave itself can be observed. Only the averaged consequences of the wave become visible.

On a small scale the wave fronts interfere. Together they form some fairly static potentials, each of which represent a typical average impact of the wave fronts. In theory a dedicated Green's function determines the contribution of the wave front to the potential. In this way the gravity potential and the electrostatic potential of the building block are formed.

In contemporary physics, red-shift is measured and interpreted as space expansion. Further the speed of information transport appears to be constant. The HBM takes this speed as a model constant. As a consequence space expansion goes together with a similar expansion of the progression step. With other words the universe wide time clock slows down as a function of progression.

The micro-path of a particle can be walked in two directions. This might relate to the sign of its spin.

Photons

A sudden change of the energy of the building block is accompanied by a temporary modulation of wave fronts. We know such modulations as photons. Since it is a modulation, its frequency can be much lower than the super high frequency of the carrier waves.. The duration of the modulation is equal to the duration of a complete micro-walk.

Such events occur for electrons that move inside atoms. These electrons move along a micro-path, which is stretched along the path of a spherical harmonic oscillation.

As a result of this stochastic movement of the electrons, their oscillation gets hidden and they behave as if they are free. Only the stationary behavior is displayed. This means that the gravity potential and the electrostatic potential stay noticeable. Due to the additional movement, the mass of the electron appears to be slightly higher.

However, if due to the fact that the electron switches to a different oscillation mode, its energy level changes, then this goes along with the emission or absorption of a photon that corresponds with the energy jump.

The fact that the energy quantum is reflected in the frequency of the photon leads to the conclusion that the photon is created/destroyed in a fixed number of progressions steps. That number corresponds to the duration of a complete micro-walk. This conclusion also means that the building blocks all contain the same number of stepping stones.

At the beginning of quantum physics physicists were astonished by this phenomenon because instead they expected EM waves that match the spherical harmonic oscillation. This story shows that the turbulent stochastic behavior of the electron hides the oscillation.

Photons ride somewhere on the super-high frequency carrier wave. Its presence is described by an object density distribution that describes the probability for the photon of being at that location. Not the photons, but instead these object density distributions control the interference of multiple photons.

The amplitude of the carrier wave reduces with distance. The photon keeps its individuality, but after travelling large distances it gets red-shifted. The red-shift is related to space expansion and to the expansion of the progression step. The speed of information transfer is a model constant. At large distance, the probability of detecting the photon diminishes, but not its capability to trigger a suitable detector. The selection of the detector is determined by the resulting frequency.

Chunks of energy

The fact that photons are energy quanta and encode their energy in their frequency leads to the suggestion that the energy quantum is divided in a discrete set of chunks. These chunks have a fixed size and are spread over the step stones that configure the micro-path. It means that in the simplest model in each micro-walk a participating step stone at the utmost can change its energy by a single energy chunk. The size of the energy chunk depends on absolute progression value. This may be due to space expansion, which also red-shifts the frequency of the photon.

This also means that a lowest and a largest photon energy exist. Their ratio is given by the number of step stones that belong to a building block.

Inertia

The background field that forms the curved continuum that we experience as "our space" is formed by the superposition (or as you wish the interference) of the wave fronts that have been emitted by all massive elementary particles. According to field theory, a particle that moves uniformly in this field goes together with a vector field. When the particle accelerates this goes together with an extra field that counteracts the acceleration. This effect is known as inertia. (This is explained in "On the origin of inertia" by Denis Sciama)

Characteristics of the micro-path

The micro-path is a stochastic object and has corresponding characteristics.

A building block type has a fixed number (N_w) of step stones. This number is determined by the efficiency of the Poisson process that generates the step stones.

The sum of steps results in a building block step (S_b). This describes the movement of the building block and it defines the building block speed (S_b/N_w).

The step between subsequent step stones has an average length (l_s) and a step length variance (v_s).

Also the object density distribution of the step stones that form the micro-path is characterized by a standard deviation.

Descriptors of the building block

The observed time clock ticks at the location of the observed item and travels with that item. Observed time differs fron the observer's time, because the information must be transported from the location of the observed item to the location of the observer. Contemporary physics uses the observer's time as its common notion of time.

Since the Hilbert Book Model applies observed time as its progression parameter it can use quaternions in order to model a flat 1+3D Euclidean parameter space that includes both progression and 3D space. In addition quaternionic functions are optimally suited for describing coherent distributions of discrete objects. Thus, quaternionic functions can be used as descriptors of building blocks.

Quaternions can be split into a scalar real part and a 3D imaginary part.

$$a \stackrel{\text{def}}{=} a_0 + \boldsymbol{a} \qquad (1)$$

(2)

$$a^* \stackrel{\text{def}}{=} a_0 - \boldsymbol{a}$$

a^* is the quaternionic conjugate of a.

$$c = ab \qquad (3a)$$

$$c_0 = a_0 b_0 - \langle \mathbf{a}, \boldsymbol{b} \rangle \tag{3b}$$

$$\boldsymbol{c} = a_0 \boldsymbol{b} + \boldsymbol{a} b_0 + \boldsymbol{a} \times \boldsymbol{b} \tag{3c}$$

Quaternionic functions can also be split into a real part and a 3D imaginary part. The real part can be interpreted as an object density distribution and the imaginary part can be interpreted as the associated current density distribution.

Quaternionic nabla

The quaternionic nabla stands for

$$\nabla \stackrel{\text{def}}{=} \left\{ \frac{\partial}{\partial \tau}, \frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z} \right\} = \{\nabla_0, \boldsymbol{\nabla}\} \tag{1}$$

Here τ stands for the progression parameter.

The nabla operator acts on differentiable quaternionic functions.

$$\psi \stackrel{\text{def}}{=} \psi_0 + \boldsymbol{\psi} \tag{2}$$

Application of the nabla operator results in a quaternionic function. The equation can be split in a real part and an imaginary part.

$$\phi = \nabla \psi \tag{3a}$$

$$\phi_0 = \nabla_0 \psi_0 - \langle \boldsymbol{\nabla}, \boldsymbol{\psi} \rangle \tag{3b}$$

$$\boldsymbol{\phi} = \nabla_0 \boldsymbol{\psi} + \boldsymbol{\nabla} \psi_0 + \boldsymbol{\nabla} \times \boldsymbol{\psi} \tag{3c}$$

(3a) is the differential equation for continuous quaternionic distributions. Rearranging shows:

$$\nabla \psi = \phi \tag{4}$$

This is the differential continuity equation.

By normalizing the operands and the resulting quaternionic function a coupling equation results.

(5)

$$\langle\psi|\psi\rangle = \int_V |\psi|^2 \, dV = 1$$

$$\nabla\psi = \phi \tag{6}$$

We also normalize a replacement φ for ϕ by dividing a by a real factor m

$$\phi = m\,\varphi \tag{7}$$

$$\langle\varphi|\varphi\rangle = \int_V |\varphi|^2 \, dV = 1 \tag{8}$$

This results in the coupling equation (7), which holds for coupled field pairs $\{\psi, \varphi\}$

$$\langle\phi|\phi\rangle = \int_V |\phi|^2 \, dV = m^2 \tag{9}$$

$$\langle\nabla\psi|\nabla\psi\rangle = \int_V |\nabla\psi|^2 \, dV = m^2 \qquad (10$$

This equation (10) only depends on ψ. Finally, the coupling equation reads:

$$\nabla\psi = m\,\varphi \tag{11}$$

This goes together with an anti-coupling equation

$$\nabla^*\varphi^* = m\psi^* \tag{12}$$

Due to the fact that the parameter space is not conjugated, equation (11) differs from equation (12).

The coupling factor m is related to the standard deviation of the step length $\sigma_s = \sqrt{v_s}$.[4]

[4] The computation of the step length variance has much in common with the computation of Feynman's path integral.

A large collection of micro-paths can correspond to the same quaternionic density distribution. A smaller set will show a direct relation of the standard deviation σ_s of the step length with the coupling factor m. The formulation and the success of Feynman's path integral indicates that the micro-path with minimal σ_s will be used by nature.

The quaternionic format of the Dirac equation for the electron is a special form of the coupling equation.

$$\nabla\psi = m\,\psi^* \tag{13}$$

The coupling equation appears to hold for elementary particles and simple composite particles.

The quaternionic format of the Dirac equation for the positron is a special form of the coupling equation for anti-particles.

$$(\nabla\psi)^* = m\,\psi \tag{14}$$

Symmetries

Due to their four dimensions, quaternionic number systems exist in 16 versions that differ in their discrete symmetry properties. Their imaginary parts offer 8 symmetry versions. The HBM assigns special indices to these versions. For example:

$$\psi^{⓪} = \psi\,;\ \psi^{⑦} = \psi^*$$

Continuous quaternionic functions do not switch their symmetry in their target space. Thus for a given parameter space continuous quaternionic functions exist in 16 versions that only differ in their discrete symmetries. If the real part represents an object density distribution and the imaginary part represents the associated current density distribution, then the function exists in 8 versions that only differ in their discrete symmetries.

In the coupling equation of elementary particles two quaternionic functions appear that only differ in their discrete symmetry. Thus:

$$\nabla\psi^x = m\,\psi^y\,;x,y = ⓪,\dots⑦$$

The Hilbert Book Model assumes that elementary particles obey a coupling equation in which the two quaternionic functions only differ in their discrete symmetry set. This delivers a choice of 8×8=64 different elementary particles[5]. They must all have different properties, but these properties need not all be measurable. Mass, electric charge and spin are measurable, but color charge is not measurable. Also 64 elementary anti-particles exist.

[5] This diversity does not include the fact that elementary particles may exist in multiple generations.

Self-oscillation

Due to the spatial spread of the step stones and the fact that the micro-path stretches along the path of movement, the building blocks are capable of self-oscillation around a center of gravity. This activity digs a cyclic ditch that is covered by the micro-path. The extra movement causes the increase of the coupling factor m, which represents the “rest”-mass of the building block.

Palestra

“Palestra” is the name of the combination of a curved embedded continuum that is implemented by a field and a finite set of particles that are recurrently embedded in this field.

The Palestra is the arena where everything takes place. In the Palestra all progression clocks are synchronized. In this way a paginated model is formed. The progression clock steps with a super-high frequency. This frequency is so high that it cannot be observed. The whole Palestra is regenerated at every progression tick. This regeneration does not occur very precisely. As a consequence the embedding of the particles into the embedding continuum differs slightly between subsequent steps. It means that the particles seems to walk along a set of step stones. A correlation mechanism takes care of the fact that the step stones form a sufficiently coherent set. The action of the correlation mechanism works in a fixed number of steps. If after this cycle the particle returns at its original location, then the particle is considered to be at rest. Otherwise the particle moves. The set of step stones that are traveled during the cycle represents the point-like particle. It can be characterized by an object density distribution and a current density distribution. The path that is traveled during a full cycle is called a micro-path. It can be characterized by a step length that has an average and a standard deviation. The object density distribution resembles the square of the modulus of the wave function of the particle.

Quantum field theory

Up to this stage this model of the Palestra does not yet involve field theory further than that the embedding continuum is considered as a field and the fact that both the object density distribution and the current density distribution can be considered as fields.

Quantum field theory (QFT) investigates the fields that transport information. Information transporting fields can be added to the model by adding the assumption that all particles emit potentials that carry information about their presence and their properties. Since particles can move, this occurs in a dynamical way. It will occur at every progression step.

The information is emitted via a wave front that slightly folds and thus curves the field that represents the embedding continuum. This is the mechanism that transports the information. It is also the mechanism that curves the embedding continuum. The subsequent wave fronts are emitted at slightly different locations. They interfere and at somewhat larger scale they form super-high frequency waves. This frequency is so high that these waves cannot be observed, but their averaged effect form the potentials whose effect becomes noticeable.

So these super-high frequency waves and the corresponding potentials form the subject of the field theory that describes information transfer. Dedicated Green's functions describe the contribution of each wave front to the corresponding potential. In this way gravitation potential and electrostatic potential can be interpreted in the paginated model.

Entangled systems

Composites that are equipped with a quantum state function that equals the superposition of the quantum state functions of its components form an entangled system. It means that the focus of the corresponding probability density distribution lays on the complete system and not on one of its components. As soon as this focus shifts to one of its components, then the properties of that component become observable.

Entanglement is governed by the correlation mechanism. For entanglement it is not necessary that the corresponding system or subsystem forms a connected composite. The quantum state function of an entangled (sub)system obeys the coupling equation. Further, entangled systems are governed by the Pauli principle.

Pauli principle

If two components of an entangled (sub)system that have the same quantum state function ϕ, are exchanged, then we can take the system location at the center of the location of the two components. Now the exchange means for bosons that the (sub)system quantum state function is not affected:

$$\text{for all } \alpha \text{ and } \beta\{\alpha\phi(-x)+\beta\phi(x)=\alpha\phi(x)+\beta\phi(-x)\}\Rightarrow\phi(-x)=\phi(x)$$

and for fermions that the corresponding part of the (sub)system quantum state function changes sign.

$$\text{for all } \alpha \text{ and } \beta\{\alpha\phi(-x)+\beta\phi(x)=-\alpha\phi(x)-\beta\phi(-x)\}\Rightarrow\phi(-x)=-\phi(x)$$

This conforms to the Pauli principle. It also indicates that the correlation mechanism, which controls the entanglement, takes care of the fact that if one of these two twin components exposes any of its properties (e.g. its spin) that it has IMMEDIATE effect on the properties of the other component. As long as none of the components is inspected, the focus is on the complete system. Inspecting a component puts focus on the component, rather than on the system as a whole.

The full story

The full story is much more complicated and takes a full e-book. For further details, please refer to: http://vixra.org/abs/1307.0106