Thou shalt construct in a modular way

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Abstract

Look around and you become easily convinced from the fact that all discrete objects are either modules or modular systems. With other words, the creator of this universe must be a modular designer. His motto is “Construct in a modular way”. However, also non-discrete items exist. Universe contains continuums and these continuums appear to relate to the discrete objects. Further, we as observers of these facts, want to place everything into an appropriate model, such that we can comprehend our environment.

If you think, then think twice.
In any case, think frankly.

Observation

The author has long thought that the foundation of physical reality is not observable. That foundation must necessarily be very simple and as a consequence its structure must be easily comprehensible by skilled scientists. So, quite probable the structure was long ago added as a part to mathematics. As a consequence the best way to investigate the foundation of reality is to use mathematical test models. However, recently the author came to the conclusion that the signature of the foundation can be observed all over universe. This signature is shown by the fact that all discrete objects in universe are either modules or they represent modular systems. However, translating this signature into a mathematical structure requires deep insight in both modular construction and in mathematical structures.

Modular construction

Diving deep into the fundamental structure of physical reality requires a deep dive into advanced mathematics. Usually this goes together with formulas or other descriptions that are incomprehensible to most people. The nice thing about this situation is that the deepest foundation of reality must be rather simple and as a consequence it can be described in a simple way and without any formulas. For example the most fundamental law of physical reality can be formulated in the form of a commandment:
“THOU SHALT CONSTRUCT IN A MODULAR WAY”
This law is the direct consequence of the structure of the deepest foundation. That foundation restricts the types of relations that may play a role in physical reality. That structure does not yet contain numbers. Therefore it does not yet contain notions such as location and time.
Modular construction acts very economic with its resources and the law thus includes an important lesson. "DO NOT SPOIL RESOURCES!"

Modular design

Understanding that the above statements indeed concern the deepest foundation of physics requires deep mathematical insight. Alternatively it requests belief from those that cannot (yet) understand this methodology. On the other hand intuition quickly leads to trust and acceptance that the above

major law must rule our existence! Modular design has the intention to keep the relational structure of the target system as simple as is possible.
Modular design is a complicated concept. Successful modular construction involves the standardization of module types and it involves the encapsulation of modules such that internal relations are hidden from the outside. Systems become complicated when many relations exist inside that system, which must be reckoned when the system is operated or changed. This plays a significant role during system configuration. The ability to configure modular systems relies heavily on the ability to couple modules and on the capability to let these modules operate in concordance.

The modular design method becomes very powerful when modules can be constructed from lower level modules. The standardization of modules enables reuse and may generate type communities. The success of a type community may depend on other type communities.

An important category of modules are the elementary modules. This are modules, which are themselves not constructed from other modules. These modules must be generated by a mechanism that constructs these elementary modules. Each elementary module type owns a private generation mechanism.
Another category are modular systems. Modular systems and modular subsystems are conglomerates of connected modules. The constituting modules are bonded. Modular subsystems can act as modules and often they can also act as independent modular systems.
The hiding of internal relations inside a module eases the configuration of modular (sub)systems. In complicated systems, modular system generation can be several orders of magnitude more efficient than the generation of equivalent monoliths.

The generation of modules and the configuration of modular (sub)systems can be performed in a stochastic or in an intelligent way. Stochastic (sub)system generation takes more resources and requires more trials than intelligent (sub)system generation.
If all discrete objects are either modules or modular systems, then intelligent (sub)system generation must wait for the arrival of intelligent modular systems.
Intelligent species can take care of the success of their own type. This includes the care about the welfare of the types on which its type depends. Thus for intelligent modular systems, modularization also includes the lesson “TAKE CARE OF THE TYPES ON WHICH YOU DEPEND”.

In reality the elementary modules appear to be generated by mechanisms that apply stochastic processes. In most cases system configuration occurs in a trial and error fashion. Only when intelligent species are present that can control system configuration will intelligent design occasionally manage the system configuration and binding process. Thus in the first phase, stochastic evolution will represent the modular system configuration drive. Due to restricted speed of information transfer, intelligent design will only occur at isolated locations. On those locations intelligent species must be present.

Mathematical model

Now we treat some aspects that involve advanced mathematics. We do that in a descriptive way.

In a modular system relations play a major role. The success of the described modular construction methodology depends on a particular relational structure that characterizes modular systems. That relational structure is in mathematics known as “orthomodular lattice”. This lattice appears to act as a suitable foundation of each modular system. However, it is also suitable as a foundation of physical reality.

In 1936 the discoverers of the orthomodular lattice published their discovery in a paper in which they called the lattice “quantum logic”. Garret Birkhoff was an expert in lattice theory and John von Neumann was a broadly oriented scientist that was especially interested in quantum physics. “quantum logic” is a strange name because in the same paper the duo showed that the set of closed subspaces of a separable Hilbert spaces has exactly the relational structure of this orthomodular lattice. The name “quantum logic” is only comprehensible, because the relational structure of this lattice is quite similar to the relational structure of classical logic and the elements of classical logic are logical propositions. It is not likely that the elements of the orthomodular lattice can be represented by logical propositions.

The orthomodular lattice extends naturally into a separable Hilbert space. Separable Hilbert spaces are mathematical constructs that act as storage media for dynamic geometric data. Quantum physicists use Hilbert spaces as a base model in which they perform their quantum physical modelling.

Hilbert spaces are linear vector spaces and each pair of Hilbert vectors owns an inner product that represents a number, which is a member of a division ring. Hilbert spaces can only cope with number systems that are division rings. This means that every non-zero element of that number system owns a unique inverse. Only three suitable division rings exist. These are the real numbers, the complex numbers and the quaternions. The quaternions form the most elaborate division ring and comprise the other division rings. The inner product of mutually perpendicular vectors equals zero.

Operators describe how Hilbert spaces map into other Hilbert spaces and can describe how Hilbert spaces map onto themselves. In the latter case, the inner product describes the relation between a Hilbert vector and its map. If the vector is mapped onto itself then the inner product adds an eigenvalue to that vector and the vector is called an eigenvector. Thus eigenvalues must be members of a division ring. If two eigenvalues differ, then their eigenvectors are perpendicular.

Number systems that are division rings can be used to define a category of operators that we will call reference operators. The rational values of the number system are used to enumerate the members of an orthonormal base of the Hilbert space. The reference operator connects the enumerator with the base vector and in this way they become eigenvalue and eigenvector. By starting from a selected reference operator, it is possible to define a category of defined normal operators that use a continuous function in order to replace the parameter value by the function value and connect this value with the corresponding eigenvector of the reference operator.

According to the discoverers of the lattice, the elements of the orthomodular lattice can be represented as closed subspaces of a separable Hilbert space, It also has sense to consider these elements as modules or modular systems. However, not every closed subspace of a separable Hilbert space represents a module or modular system. Thus, compared to closed subspaces of the Hilbert space, will modules and modular systems have extra characteristics.

Elementary modules are represented by one-dimensional subspaces of the Hilbert space. Not every one-dimensional subspace of the Hilbert space represents an elementary module. But, if the one-dimensional subspace represents an elementary module, then the spanning Hilbert vector is eigenvector of a normal operator that connects an eigenvalue to the elementary module. Thus, elementary modules are characterized by an eigenvalue and an eigenvector that belong to a special normal operator. That operator is not a reference operator and it is not a defined normal operator. It is member of a new category of operators that we will call stochastic operators.

Quaternions can be interpreted as a combination of a scalar progression value and a three dimensional spatial location. The scalar part is the real part of the quaternion and the vector part is the imaginary part. Quaternions can represent other subjects, but in this paper the representation of dynamic geometric data plays a major role.

Thus in this view the elementary module is represented by a single progression value and a single location. In reality elementary modules are characterized by a dynamic geometric location. We must extend the representation of the elementary module such that it covers a sequence of locations that each belong to a progression value. After ordering of the progression values the elementary module appears to walk along a hopping path and the landing positions form a location swarm.

Mechanisms

From reality we know that the hopping path is not an arbitrary path and the location swarm is not a chaotic collection. Instead the swarm forms a coherent set of locations that can be characterized by a rather continuous location density distribution.

From physics we know that elementary particles own a wave function and the squared modulus of that wave function forms a continuous probability density distribution, which can be interpreted as a location density distribution of a point-like object. The location density distribution owns a Fourier transform and as a consequence the swarm owns a displacement generator. This means that at first approximation the swarm can be considered to move as one unit. Thus the swarm is a coherent, rather smoothly moving object, which represents the violent stochastic hopping of a point-like object. For a large part this is due to the fact that the swarm contains a huge number of locations that is refreshed in a cyclic fashion.

The fact that at every progression instant the swarm owns a Fourier transform means that at every progression instant the swarm can be interpreted as a wave package. Wave packages can represent interference patterns, thus they can simulate wave behavior. The problem is that moving wave packages tend to disperse. The swarm does not suffer that problem because at every progression instant the wave package is regenerated. The result is that the elementary module shows wave behavior and at the same time it shows particle behavior. When it is detected it is caught at the precise location where it was at this progression instant.

The Hilbert space is nothing more and nothing less than a structured storage medium for dynamic geometric data. It does not contain functionality that ensures the coherent dynamic behavior of the location swarms. Dedicated mechanisms, which do not belong to the household of the Hilbert space fill the eigenspaces of the stochastic operators that control the elementary modules. The hopping path only stops when the elementary module is “detected” and the controlling mechanism changes to a different mode of operation.

Dynamic model

Next we construct a vane that splits the Hilbert space such that all elementary module eigenvalues that have a selected real value have the corresponding eigenvector inside the vane. Thus the vane splits the Hilbert space in an historic part, the vane itself and a future part. The vane then represents a static status quo that corresponds to the current state of the universe.

This represents an interesting possibility. The Hilbert space can be seen as a storage medium that contains a repository of all historic, present and future data. Or it can be interpreted as a scene that is observed by objects that travel with the vane. These observers might know part of the stored history, but have no notion of the future. Depending on their capabilities, the observers reflect only a part of their history. Information that inside the vane is generated at a distance has still to travel through space in order to reach the observer. The encounter will take place in the future.

Information that reaches the observer arrives from the past. That information travels via information carriers.

The vane forms a subspace of the Hilbert space and for each elementary module that subspace contains a single Hilbert vector that plays as eigenvector for the corresponding geometric location. This location is the landing point of a hop rather than the geometric center of the location swarm.

Fields

Each infinite dimensional separable Hilbert space owns a unique companion non-separable Hilbert space that features operators, which have continuum eigenspaces. Such eigenspaces can form flat parameter spaces or dynamic fields. This can easily be comprehended when in the non-separable Hilbert space a similar procedure is used in which reference operators and defined normal operators are specified that apply the same defining functions.

The hopping path that represents an elementary particle, corresponds to a coherent location swarm, which is characterized by a location density distribution. Via the convolution of the Green's function of the field and this location density distribution, the swarm corresponds to a deformed part of the field that in this way describes all elementary modules. The convolution means that the Green's function blurs the location density distribution. This can be interpreted as if the hopping landing locations influence the field, but the alternative interpretation is that the field is a kind of descriptor of the hopping landing locations. Anyway the landing locations and the discussed field are intimately coupled. The deformed field can be interpreted as the living space of the modules and modular systems.

Stochastic processes

The mechanisms that generate the hopping landing location control the dynamics of the model. These mechanisms use stochastic processes. These processes appear to belong to a category which is mathematically known as inhomogeneous spatial Poisson point processes. In more detail these processes probably are modified Thomas processes.

Physical theories stop at the wave function of particles. This exposure dives deeper and reaches the characteristic function of the stochastic process that controls the generation of the landing locations that form the hopping path.

Self-coherence

It is difficult to belief in a creator that installs separate mechanisms, which ensure the dynamic coherence of the generated modules. It is easier to accept that the relation between the generated location swarms and the field that describes these swarms is based on a mathematically explainable kind of self-coherence. In case of self-coherence, the interaction between the field and the swarm restricts the possible location density distribution. This restriction may be influenced by the number of elements that are contained in the swarm. This fact may explain the existence of generations of elementary modules.

In the relation between the swarm and the field, the Green's function of the field plays an important role. It plays the role of a potential that implements an attracting force. Another factor is the kind of stochastic process that generates the individual locations. This process belongs to the category of the inhomogeneous spatial Poisson point processes. Each hop tries to displace the geometric center of the swarm. This displacement represents an acceleration. Let the Green's function represent a scalar potential. When the platform on which the elementary object resides moves with respect to the background parameter space with a uniform speed, then the scalar potential will in that coordinate system turn into a vector potential. Differential calculus learns that the dynamic change of the vector field goes together with a new field that counteracts the acceleration. This effect is similar to the phenomenon that is known as inertia. It looks as if the center of geometry of the swarm is attracting the accelerating hopping elementary object. This is an effective kind of self-coherence.

In order to elucidate this obscure description, we will explain this by applying formulas.

The Green's function $G(\boldsymbol{q})$ represents a scalar potential.

$$G(\boldsymbol{q}) = m_1/|\boldsymbol{q} - \boldsymbol{c}| \tag{1}$$

If the platform travels with uniform speed $\boldsymbol{v}$, then this corresponds with a vector potential:

$$\boldsymbol{A}(\boldsymbol{q}) = G(\boldsymbol{q})\boldsymbol{v} \tag{2}$$

Acceleration goes together with a new field $\boldsymbol{E}(\boldsymbol{q})$:

$$\boldsymbol{E}(\boldsymbol{q}) \stackrel{\text{def}}{=} \dot{\boldsymbol{A}}(\boldsymbol{q}) = G(\boldsymbol{q})\dot{\boldsymbol{v}} \tag{3}$$

This goes together with an attracting force $\boldsymbol{F}(\boldsymbol{q})$

$$\boldsymbol{F}(\boldsymbol{q}) = m_2\, \boldsymbol{E}(\boldsymbol{q}) \tag{4}$$

This attractive force acts between the landing location **c** of the hopping object and the geometric center of the swarm. $\dot{\boldsymbol{v}}$ is the acceleration of the geometric center of the swarm that is due to the addition of the individual hop. The swarm covers a huge number of landing locations.

The location density distribution of the swarm is blurred by the Green's function. If the location density distribution has the form of a Gaussian distribution, then the blurred function is the convolution of this location density distribution and the Green's function. The shape of this example is given by:

$$\chi_n(r) = -\frac{C_n}{4\pi} \frac{ERF\left({}^{r}/_{\sigma\sqrt{2}}\right)}{r} \tag{5}$$

This is just an example. Such extra potentials add a local contribution to the field that acts as the living space of modules and modular systems. The extra contribution is due to the local elementary module.

The symmetry related field

The convolution involves an integration and the local contribution to the integral involves two parameter spaces. These parameter spaces may differ in their ordering. In order to cope for this difference the platform on which the elementary object resides must be encapsulated. The boundary must only cross regions of the parameter spaces where the field and the extra potential are both continuous. In fact the charges characterize the parameter spaces rather than the deformed fields. For the parameter spaces the condition is automatically fulfilled and therefore the shape of the boundary does not matter. For that reason we select a boundary that has the form of a cube, whose axes are aligned along the axes of the Cartesian coordinate systems that are used to order the concerned parameter spaces. This procedure enables the correct accounting for the differences in the ordering. This accounting process reveals the charges that go together with the difference in ordering. This reveals the short list of electric charges and the color charges that appear in the SM.

The charges will be located on the geometric centers of the floating platforms. These ***symmetry related charges*** are the source of a new separate basic field that we will call the ***symmetry related field***. This field differs fundamentally of the field that represents our living space.

More detail

Those that possess sufficient knowledge of mathematics might be interested in the paper "The Hilbert Book Test Model"; This pure mathematical model exploits the above view. See: http://vixra.org/abs/1603.0021