Coherent stochastic mechanisms

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Abstract

In intimate cooperation, symmetry centers and coherent stochastic mechanisms recurrently recreate elementary physical objects. Symmetry centers are dedicated subspaces of separable quaternionic Hilbert spaces. As such they are no more and no less than structured storage places that feature special properties. The coherent stochastic mechanisms are the actors that generate and control coherent dynamics. Tri-state flavor switching appears to fit similar quaternionic representation as dynamic geometry does.

If the paper introduces new science, then it has fulfilled its purpose.

Contents

1 Introduction

This paper is an excerpt that is taken from the paper “The Axiomatic Foundations of Physical Reality”; [2]. That paper describes an orthomodular base model that consists of an infinite dimensional quaternionic separable Hilbert space and its companion Gelfand triple. Without the addition of coherent stochastic mechanisms this model cannot deliver any coherent dynamic behavior. These mechanisms attach to symmetry centers which are a special category of closed subspaces of the separable Hilbert space. Symmetry centers exist in several versions.

A special category of well-ordered normal operators are used to install extra structure in the orthomodular base model. These operators introduce the notions of progression and space. Progression is used as enumerator of other ordering processes. Progression values are eigenvalues of the Hermitian part $\mathcal{R}_0 = \left(\mathcal{R} + \mathcal{R}^\dagger\right)/2$ of a normal reference operator $\mathcal{R}$ that together with its companion reference operator $\mathfrak{R}$ in the Gelfand triple deliver the parameter spaces of the model.

Symmetry centers are eigenspaces of special anti-Hermitian operators $\mathfrak{S}^x$ that feature special symmetry properties, which are indicated by superscript ^{x}. These eigenspaces are supposed to float on parameter space $\mathcal{R}$.

2 Symmetry centers

Symmetry centers are eigenspaces of a special kind of anti-Hermitian operators $\mathfrak{S}^x$ that reside in an infinite dimensional separable quaternionic Hilbert space. The eigenspace of these operators are spanned by rational imaginary quaternions and are ordered in accordance to a spherical coordinate system. This ordering starts with a Cartesian coordinate system. The ordering can be done in several ways. Already the Cartesian ordering can be done in eight different ways. Cartesian ordering starts with the selection of the orientation of the coordinate axes. Next the spherical ordering may start with the polar angle or with the azimuth. Finally the radius is ordered. The range of the polar angle is 2π radians and the range of the azimuth is π radians.

If symmetry centers float on a background space $\mathcal{R}$ that also is ordered via a Cartesian coordinate system, then the difference between the orderings can affect processes that use both spaces. It appears that properties of combinations of the underlying spaces are constituting the origin of many of the properties of products of mechanisms that generate discrete physical objects. Examples are electric charge, color charge and spin [1].

3 Coherent stochastic mechanisms

The most mysterious creatures in physical reality are the coherent stochastic mechanisms. They act as cyclic functions of progression and work in a step-wise fashion. They pick locations from symmetry centers and store them in eigenspaces of dedicated operators that reside in an infinite dimensional separable quaternionic Hilbert space. At the same time these locations are embedded in a continuum that act as our living space and exists as the eigenspace of an operator that resides in the Gelfand triple that belongs to the Hilbert space. In this way a coherent stochastic mechanism recurrently recreates an elementary physical object.

The type of the mechanism conforms to the type of the symmetry center. However the diversity of the mechanisms is greater than the diversity of the symmetry centers. The mechanisms exist in multiple generation flavors. The activity of the coherent stochastic mechanism is based on a sequence of stochastic processes. The first process creates a germ and that germ is used to control a binomial process that is implemented by a spatial spread function. Angles may be selected by uniform random selection processes. The mechanism picks certain locations of the symmetry center and stores this result in the eigenspace of a target operator. These processes work in such a way that the resulting location swarm can be described by a continuous location density distribution. That distribution has a Fourier transform. The location swarm corresponds to a hopping path. The density distribution corresponds to the squared modulus of a probability amplitude distribution. These functions characterize an elementary object.

4 Coherence

The adjective "coherent" is used to indicate that the coherent stochastic mechanisms prevent the generation of dynamic chaos. The mechanisms ensure this by storing their results in the separable Hilbert space and by ensuring that the generated location swarm can be described by a continuous location density distribution, which owns a Fourier transform. As a consequence at first approximation the swarm displaces as one unit and owns a private displacement generator. This moderates the dynamic behavior of the elementary modules.

5 RTOS

The existence of the Hermitian operator $\mathcal{R}_0 = (\mathcal{R} + \mathcal{R}^\dagger)/2$ makes it possible to introduce a model-wide clock that registers progression as a model-wide parameter. The clock is used to synchronize all generation and configuration actions that take place in the model. When elementary particles are modules that join in higher order modules in order to configure modular systems or modular subsystems, then the configuration process may encounter problems that might occur in Real Time Operating Systems. Examples of these problems are dead locks and race conditions in multi-threaded systems. Computer system designers fight these problems with drastic contra measures, such as watchdogs that restart the whole system or part of the system. The recurrent stochastic regeneration of the elementary modules that is implemented by the coherent stochastic mechanisms represent an effective preventive measure against these typical RTOS scheduling flaws.

6 Tri-state spaces

Quaternions not only fit in the representation of dynamic geometric data. They also match in representing three-fold states such as the RGB colors of quarks and the three generation flavors of fermions. In all these roles the real part of the quaternion plays the role of progression. Thus quaternions can also be used to model neutrino flavor mixing.

Say that a property is distributed over three mutually independent modes and these modes exist in a combination that superposes these three modes.

The property distribution is characterized by p_x, p_y, p_z

$$\cos^2(\theta_x) = \frac{p_x}{p_x + p_y + p_z}$$

$$\cos^2(\theta_x) + \cos^2(\theta_y) + \cos^2(\theta_z) = 1$$

The angles $\theta_x, \theta_y, \theta_z$ indicate a direction vector $\mathbf{n} = \{n_x, n_y, n_z\}$ in three dimensional state space.

$$|n_x|^2 = \frac{p_x}{p_x + p_y + p_z}$$

$$\cos(\theta_x) = n_x;\ |\boldsymbol{n}| = 1$$

If state mixing is a dynamic process, then the axis along direction vector $\boldsymbol{n}$ acts as the rotation axis. The concerned subsystem rotates smoothly as a function of progression. This is not a rotation in configuration space. Instead it is a rotation in tri-state space.

The fact that quaternions can rotate the imaginary part of other quaternions or of complete quaternionic functions also holds for tri-states. The quaternions that have equal real and imaginary size play a special role. They can shift an anisotropic property to another dimension. They can play a role in tri-state flavor switching.

E.M. Lipmanov has indicated that generation flavor mixing is related to a special direction vector in ordered three dimensional space [3][4]. This singles out a direction vector in the 3D phase space. That direction vector is defined by the angles of this vector with respect to the base vectors of the Cartesian coordinate system of that phase space.

$$\cos^2(2\,\theta_{12}) + \cos^2(2\,\theta_{23}) + \cos^2(2\,\theta_{31}) = 1$$

$$\cos^2(2\,\theta_{e}) + \cos^2(2\,\theta_{\mu}) + \cos^2(2\,\theta_{\tau}) = 1$$

$$\cos^2(2\,\theta_{u}) + \cos^2(2\,\theta_{c}) + \cos^2(2\,\theta_{t}) = 1$$

$$\cos^2(2\,\theta_{d}) + \cos^2(2\,\theta_{s}) + \cos^2(2\,\theta_{b}) = 1$$

The projection of the direction vector on the coordinate base vectors appears to relate to generation masses. Generation flavor mixing is well known as a phenomenon that occurs for neutrinos when they travel through space.

In the orthomodular base model the rest mass of the elementary particle is related to the number of the elements in the location swarm that the mechanism picks from the symmetry center.

7 Physical theories

Physical theories tend to ignore the existence of the coherent stochastic mechanisms. However, the probability amplitude distribution is known as the wave function of the elementary object. It is the main indication of the existence of the coherent stochastic mechanisms. The coherent stochastic mechanisms are not part of the Hilbert space. Instead they use this structure as a storage medium.

Coherent stochastic mechanisms live at the rim between history and future. History is stored in eigenspaces of operators that reside in the Hilbert space or in its Gelfand triple. The future is unknown. Progression steps in the Hilbert space and flows in the Gelfand triple. Fields are stored in the eigenspaces of operators that reside in the Gelfand triple.

8 Summary

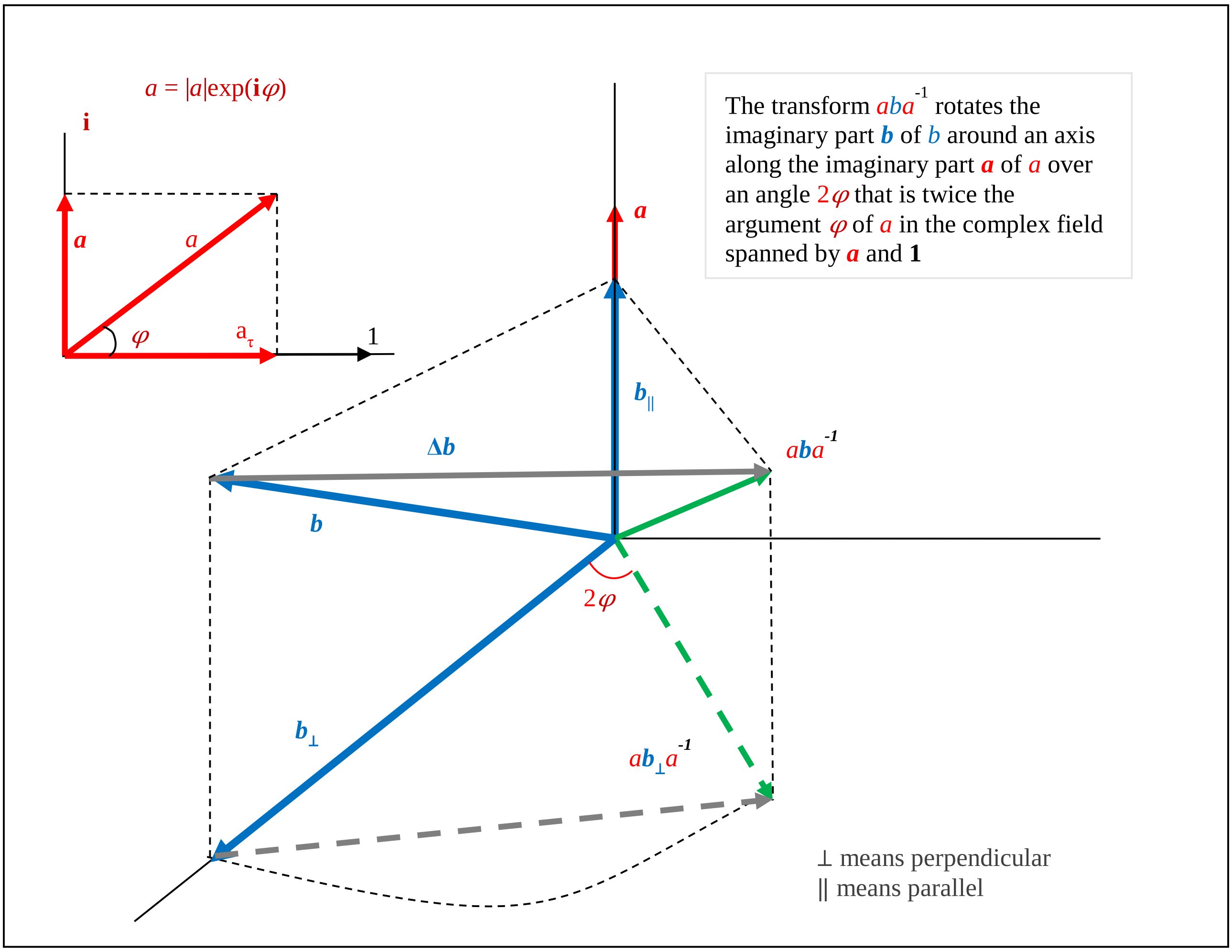
Coherent stochastic mechanisms are the main reason of the existence of coherent dynamics in universe. Without these mechanisms, nothing would happen.

The Hilbert space and its companion Gelfand triple are no more and no less than structured storage media. The coherent stochastic mechanisms bring action into this theater.

9 Appendix

9.1 Quaternionic rotation

In multiplication quaternions do not commute. Thus, in general $a\, b/a \neq b$. In this multiplication the imaginary part of b that is perpendicular to the imaginary part of a is rotated over an angle φ that is twice the complex phase of a.



This means that if $\varphi = \pi/4$, then the rotation $c = a\, b/a$ shifts $\boldsymbol{b}_\perp$ to another dimension. This fact puts quaternions that feature the same size of the real part as the size of the imaginary part is in a special category. They can switch states of tri-state systems.

9.2 State shifters

Via quaternionic rotation, the following normalized quaternions ϱ^x can shift the indices of symmetry flavors of coordinate mapped quaternions and for quaternionic functions:

$$\varrho^{①} = \frac{1+\boldsymbol{i}}{\sqrt{2}};\ \varrho^{②} = \frac{1+\boldsymbol{j}}{\sqrt{2}};\varrho^{③} = \frac{1+\boldsymbol{k}}{\sqrt{2}};\ \varrho^{④} = \frac{1-\boldsymbol{k}}{\sqrt{2}};\ \varrho^{⑤} = \frac{1-\boldsymbol{j}}{\sqrt{2}};\ \varrho^{⑥} = \frac{1-\boldsymbol{i}}{\sqrt{2}} \quad (1)$$

$$\boldsymbol{ij} = \boldsymbol{k};\ \ \boldsymbol{jk} = \boldsymbol{i};\ \ \boldsymbol{ki} = \boldsymbol{j} \quad (2)$$

$$\varrho^{⑥} = \left(\varrho^{①}\right)^{*} \tag{3}$$

For example

$$\psi^{③} = \varrho^{①}\psi^{②}/\varrho^{①} \tag{4}$$

$$\psi^{③}\varrho^{①} = \varrho^{①}\psi^{②} \tag{5}$$

10 References

[1] Symmetry centers are introduced in "On the Origin of Electric Charge"; http://vixra.org/abs/1507.0185

[2] A more detailed description of both symmetry centers and coherent stochastic mechanisms is presented in “Foundations of a Mathematical Model of Physical Reality”; http://vixra.org/abs/1502.0186

[3] “Neutrino Oscillations”; http://www2.warwick.ac.uk/fac/sci/physics/current/teach/module_home/px435/lec_oscillations.pdf .

[4] “On Radical Ph-Solution of Number 3 Puzzle and Universal Pattern of SM Large Hierarchies“; http://arxiv.org/abs/1212.1417