Modularity in the universe

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Abstract

All massive objects in the universe behave as modules. All modules are recurrently regenerated by private stochastic processes. These processes install the coherence of the module and control the binding of components in composed modules.

1 Introduction

All massive objects in the universe are modules. Elementary modules exist that configure all other modules, and some modules constitute modular systems [1].

2 Elementary modules

For each elementary module, a private stochastic process exists that owns a characteristic function and that at subsequent instants generates a new location of the elementary module. Thus, the elementary module hops around in a stochastic hopping path. The hop landing locations form a coherent and dense hop landing location swarm. A location density distribution describes the swarm and equals the squared modulus of what physicists call the wavefunction of the elementary particle. The location density distribution also equals the Fourier transform of the characteristic function of the stochastic process.

Each hop embeds a quaternion into the quaternionic embedding field. If this embedding breaks the chiral symmetry of the embedding field in an isotropic way, then the hop landing causes a spherical pulse response. The spherical pulse response integrates into the Green's function of the embedding field. This function features a volume. Consequently, the spherical pulse response pumps some volume into the quaternionic embedding field. This locally deforms the field. The volume spreads over the field. Thus the deformation quickly fades away. If the stochastic process recurrently regenerates the hop landing location swarm, such that the spherical shock fronts sufficiently overlap in time as well as in space, then the presence of the elementary module causes a persistent deformation. That deformation means that the elementary module owns an amount of mass. This mass is a very transient property because the deformation must recurrently be regenerated and subsequently it dilutes into the expansion of the embedding field.

2.1 Platform

Elementary modules live on a private platform, which is a separable Hilbert space. That Hilbert space applies a version of the quaternionic number system for the specification of the inner product of pairs of Hilbert space vectors. These numbers will also be used as eigenvalues of operators. A reference operator uses the selected version of the number system as its eigenspace [2]. It provides the Hilbert space with its own private parameter space. A dedicated operator stores the hop landing locations in its eigenspace. Within the platform, the stochastic hopping path is closed.

2.2 Embedding

The embedding field is eigenspace of an operator that resides in a non-separable Hilbert space. It is the unique companion of an infinite dimensional separable Hilbert space that acts as a background platform. The non-separable Hilbert space embeds its separable companion without any chiral symmetry breaking.

The platforms that belong to the elementary modules float over the background platform. Thus, the parameter space of the platform of the elementary modules floats over the background parameter space.

The breaking of chiral symmetry can occur due to the discrepancy of the symmetries or the handiness of the embedded platform and the embedding platform. This is determined by the chiral symmetry properties of the concerned parameter spaces.
A gauge factor multiplies with the characteristic function and implements a displacement generator for the swarm as a whole. On the platform, the hopping path is closed, but the image of the hopping path onto the embedding field is not closed. Consequently, the image of the swarm moves together with its platform as a single unit over the embedding field.

3 Composed modules

A private stochastic process also controls the composed modules. The characteristic function of this stochastic process equals a dynamic superposition of the characteristic functions of the stochastic processes of the components. The superposition coefficients act as gauge factors, which in their turn act as internal displacement generators. Thus, the superposition coefficients control internal movements. Internal movements must be oscillations. The modules also own an overall gauge factor, which acts as a displacement generator for the whole module.
In other words, the stochastic processes play a crucial role in the binding of the components of a module. This is enforced by the mutual attraction of the constituents that is caused by the deformation and the expansion of the embedding field.

4 Lessons

The fact that nature chooses modularization as its major design method teaches us some lessons.

Modularity appears to be a very efficient design and construction methodology. The method uses its resources very economically. It enables reuse of existing modules. It simplifies the design of complicated systems. It simplifies support and repair. It can reduce design and construction time with orders of magnitude. It enables type communities. It is capable of producing intelligent species. It enables intelligent and automated design and construction. It stimulates to take care of types on which one depends.

References

The Hilbert Book Model Project [3] explores the mathematical foundation of physical reality. An e-print archive [4] contains documents that highlight certain aspects of this project.

[1] “Structure in Physical Reality”; http://vixra.org/abs/1802.0086

[2] https://golem.ph.utexas.edu/category/2010/12/solers_theorem.html

[3] https://en.wikiversity.org/wiki/Hilbert_Book_Model_Project

[4] http://vixra.org/author/j_a_j_van_leunen